Ocean City, Maryland

2017 Hazard Mitigation Plan

Adopted: 2017

Ideas for Today and Tomorrow

RECORD OF CHANGE

PAGE NUMBER	SECTION AFFECTED AND COMMENTS	DATE OF CHANGE

TABLE OF CONTENTS

APPENDIX

APPENDIX

LIST OF TABLES

LIST OF MAPS

LIST OF FIGURES

EXECUTIVE SUMMARY

The Town of Ocean City has experienced numerous hazard incidents throughout its history and has undertaken mitigation actions and projects to minimize risk and future losses. The most significant hazard mitigation initiative undertaken to date is the ongoing Ocean City Beach Replenishment Project, initiated in 1988. The project is a cooperative effort between the State of Maryland, Worcester County, and Ocean City. To further guide mitigation initiatives and continue these disaster resistance and resilience efforts, the *2017 Ocean City Hazard Mitigation Plan* has been developed to serve as a comprehensive, long-range plan that identifies mitigation implementation actions. The 2017 Plan is not merely an update to previous Plan iterations, but rather a new Plan document to guide Ocean City's hazard mitigation and resiliency efforts through 2021.

2017 Plan Highlights include:

- ✓ A robust and inclusive Hazard Mitigation Planning Committee (HMPC) was assembled to inform the plan develop process and content.

- ✓ In order to assess the planning area, six divisions were used. These divisions were based upon public safety response areas. Mapping products within the Plan included the six divisions allowing for targeted depictions and analysis.

- ✓ A new community capability assessment was completed. HMPC members assessed four types of capabilities: Planning and Regulatory, Administrative and Technical, Education and Outreach, and Financial.

- ✓ A new critical facilities database was created and used for hazard vulnerability assessments within the Plan.

- ✓ An Enhanced Coastal Flood Hazus was conducted. User defined facilities were imported into the Hazus program, refined data was utilized as opposed to the program's default data resulting in a more detailed and accurate analysis results. Updated critical facilities database was included in the analysis, as well.

- ✓ Fourteen new mitigation actions were identified during the 2017 Plan Update.

- ✓ A new community resiliency section was added to the 2017 Plan Update.

- ✓ In order to facilitate plan integration amongst Ocean City's planning documents and mechanisms, a Safe Growth Audit was conducted as a new 2017 plan component.

- ✓ A National Flood Insurance Program (NFIP) and Community Rating System (CRS) Appendix was added as part of the 2017 Plan development process. The appendix helps to satisfy CRS Floodplain Management Planning requirements,

thereby enabling Ocean City to improve their CRS rating, which may lower NFIP insurance premiums for the entire community.

- ✓ Repetitive loss areas were identified within the National Flood Insurance Program (NFIP) and Community Rating System (CRS) Appendix.

The 2017 Plan has been organized into three sections and nine appendices. This document meets the intent of the Disaster Mitigation Act of 2000, which specifically addresses hazard mitigation planning and requires local governments to prepare a hazard mitigation plan as a precondition for receiving FEMA mitigation project grants.

INTRODUCTION

The process of updating the *2017 Town of Ocean City Hazard Mitigation Plan* followed the nine recommended tasks outlined in the *FEMA Local Mitigation Planning Handbook, March 2013.* The *Handbook* developed by FEMA is intended to help local officials develop Hazard Mitigation Plans.

The plan organization includes four (4) sections with associated FEMA recommended tasks completed within each. Figure 1.1 illustrates the plan organization and content with each plan section.

Figure 1-1: Mitigation Planning Tasks 1-9

SECTION 1 **Discuss the process and people needed to complete the remaining mitigation planning and the best ways to document the process in the plan.**	**TASK 1**	Determine the Planning Area and Resources
	TASK 2	Build the Planning Team
	TASK 3	Create an Outreach Strategy
SECTION 2 **Cover the specific analyses and decisions that need to be completed and recorded in the plan.**	**TASK 4**	Review Community Capabilities
	TASK 5	Conduct a Risk Assessment
SECTION 3 **Develop strategies to mitigate prioritized hazards.**	**TASK 6**	Develop a Mitigation Strategy
	TASK 7	Keep the Plan Current
	TASK 8	Review and Adopt the Plan
SECTION 4 **Provides suggestions and resources for implementing your plan and reduce risk.**	**TASK 9**	Create a Safe and Resilient Community

Guiding Principles for Plan Development – 2013 FEMA Local Mitigation Plan Handbook

When developing the mitigation plan, keep the following guiding principles in mind:

- ***Focus on the mitigation strategy.*** The mitigation strategy is the plan's primary purpose. All other sections contribute to and inform the mitigation strategy and specific hazard mitigation actions.
- ***Process is an important as the plan itself.*** In mitigation planning, as with most other planning efforts, the plan is only as good as the process and people involved in its development. The plan should also serve as the written record, or documentation, of the planning process.
- ***This is your community's plan.*** To have value, the plan must represent the current needs and values of the community and be useful for local stakeholders. Develop the mitigation plan in a way that best serves your community's purpose and people.

Disaster Mitigation Act of 2000

The purpose of the Stafford Act, as amended by the Disaster Mitigation Act of 2000, is "to reduce the loss of life and property, human suffering, economic disruption, and disaster assistance costs resulting from natural disasters."

Section 322 of the act specifically addresses mitigation planning and requires state and local governments to prepare multi-hazard mitigation plans as a precondition for receiving FEMA mitigation project grants.

Source: Local Mitigation Planning Handbook - 2013

ORGANIZATON OF THE PLAN

The Town of Ocean City Hazard Mitigation Plan is organized into the nine recommended tasks for updating the Plan. Some of the tasks were completed concurrently, while others were dependent upon completion of prior tasks. Tasks 1-3 provide the process, people, and resources used to update the hazard mitigation plan. Tasks 4-8 provides the data, analysis, and strategies to enable the planning team to make decisions for incorporation into the plan. The final task, Task 9, provides an implementation action plan for creating a safe and resilient community.

Section I –Resource Organization

TASK 1	Determine the Planning Area and Resources	Chapter 1- Planning Area and Resources
TASK 2	Build the Planning Team	Chapter 2- Planning Team
TASK 3	Create an Outreach Strategy	Chapter 3- Outreach Strategy

Section I – Resource Organization includes background information on the Town of Ocean City. Background information includes demographics and development trends. As part of the 2017 plan development process, the idea of splitting the planning area, Ocean City proper, into six planning divisions was conceived and implemented. The six planning divisions are utilized throughout the Plan to emphasize areas of concern, such as those areas that display a higher risk to s specific hazards than other areas within the Town.

Also, included in Section I is information on the development and composition of the 2015-2016 Hazard Mitigation Planning Committee. Finally, a new chapter was added to the 2017 Plan, that was not included in previous plan versions, an outreach strategy chapter. This chapter highlights outreach efforts undertaken by the Town, the ongoing process, and new information added and available as a result of the 2017 Plan Update.

Chapter 1- Planning Area and Resources

PLANNING AREA

The Town of Ocean City was founded as a fishing village over 125 years ago, and was incorporated by the State of Maryland in 1898. One of four municipalities in Worcester County, the town occupies approximately five square miles and is located on a barrier island about 150 miles from Washington, D.C., and 135 miles from Baltimore, Maryland.

From its modest beginnings, Ocean City has emerged as one of the primary full service seaside resorts on the east coast. Maryland's only ocean resort, the town hosts over 8,000,000 visitors annually and generates nearly $3 billion into the State's economy.

Originally, tourism consisted of boarding houses and cottages, run by the wives of commercial fisherman. Now hotel chains, family owned motels, bed and breakfasts, condominiums, townhouses, and single-family homes provide a variety of living choices.

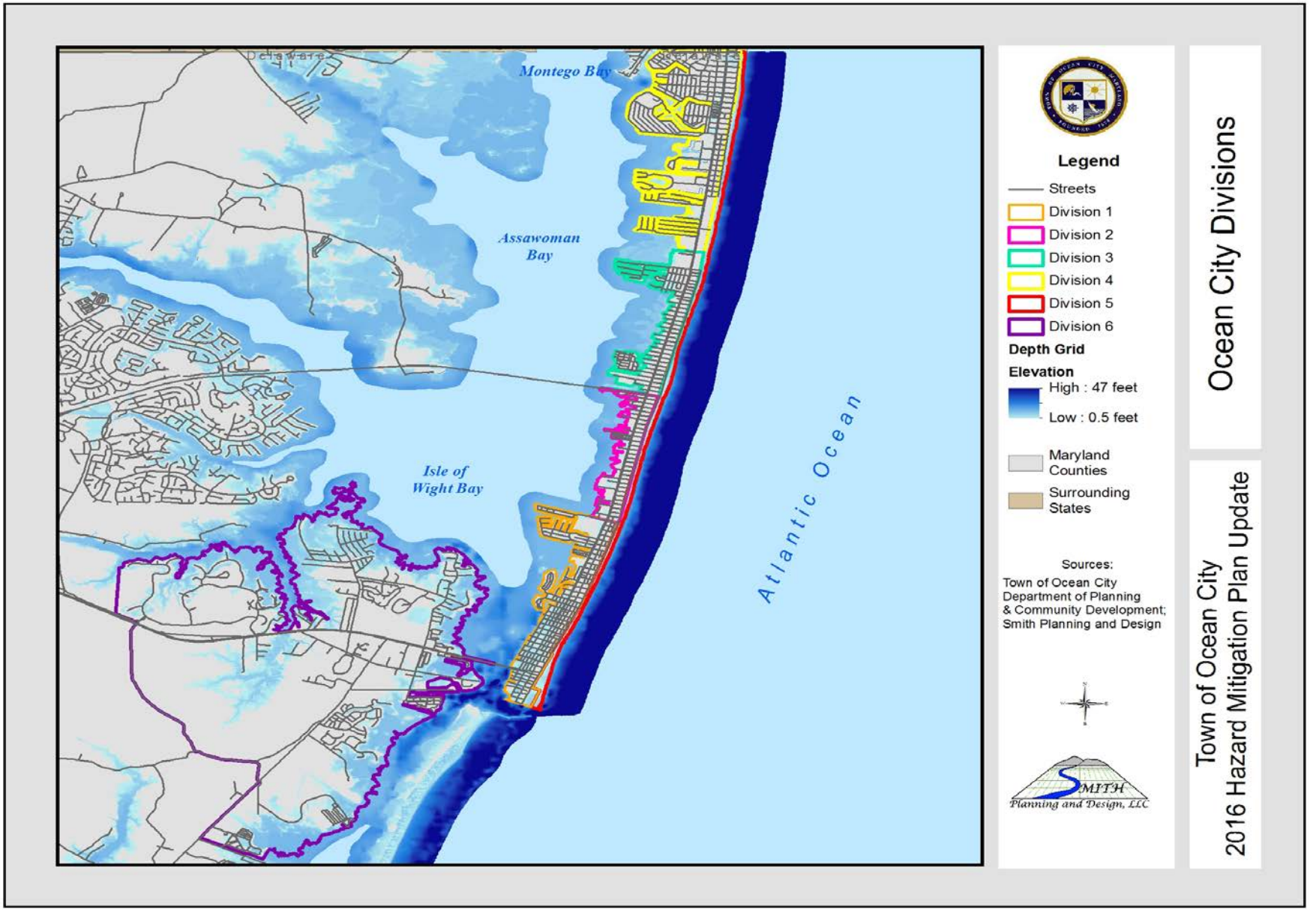
Geographically, Ocean City is a flat, narrow strip of sand preserved by dunes, beach replenishment, and jetties. Nearly any part of the town is equally vulnerable to any of the hazards described within this report. History has shown that all properties in Ocean City are subject to damage from natural hazards, some properties more than others due to their construction quality or their proximity to the bay or ocean. Oceanfront structures will endure high winds and waves off the ocean while Bayfront structures will see flooding and debris damage caused by floating materials and high winds. Bayside properties do not have the protection of any dunes, seawall, or jetties to interrupt incoming waves and high tides, only bulkheads. The town's limits are finite, with Delaware bordering to the north, as bay to the west, an inlet to the south, and an ocean to the east. West Ocean City is a part of Worcester County, Maryland and shall remain that way.

Located beyond the barrier islands of Maryland's Atlantic shore, the Atlantic Continental Shelf Province is the submerged continuation of the Coastal Plain Province, which extends eastward for about 75 miles. The Atlantic Continental Shelf Province is comprised primarily of sand deposits.

1.1 Division of Planning Area

The Town of Ocean City is five square miles and is linear in shape, running north to south. In order to assess the area, six divisions have been created. These divisions or sub-areas are based upon public safety response areas. For purposes of the Plan, divisions will be used as base mapping on all exhibits. The divisions will enable targeted depictions and analysis for mitigation strategies.

Map 1-1: Ocean City Divisions



1.2 Population

As shown in Table 1-1 and 1-2, the town provides services for two different populations – the permanent year-round population of 7,089, (U.S. Census Bureau), and the peak summer population of about 300,000. Ocean City has experienced consistent, and in some time periods, remarkable growth.

The growth since the 1970's resulted from the increasing tourist economy enabling more households to be supported year-round by the summer trade, and the expansion of public facilities to serve an increasing population. In addition, there has been an influx of retirees who have found Ocean City to be a desirable place to live. The 2014 Census shows that about 39% of Ocean City's 7,089 permanent residents are 60 years of age and older. Baby Boomers is the name given to the generation of Americans who were born in a "baby boom" following World War II. The Boomers were born between 1944 and 1964. The oldest of Baby Boomers is currently considering retirement options and looking at ways to make their elder years meaningful. This group is now aging and visiting Ocean City. Services to support this age bracket will always be an important planning issue.

It is projected that the town's permanent population will continue to grow at a steady rate for the foreseeable future, with a projected population in 2030 of about 9,473.

Table 1-1: Year-Round Population

Year-Round Population		
Year	**Population**	**Avg. Annual Change**
1930	946	-
1940	1,052	1.1%
1950	1,234	1.7%
1960	983	-2.0%
1970	1,493	5.2%
1980	4,946	23.1%
1990	5,146	0.4%
2000	7,173	3.7%
2010	7,102	-1%
2014	7,089	-0.2%

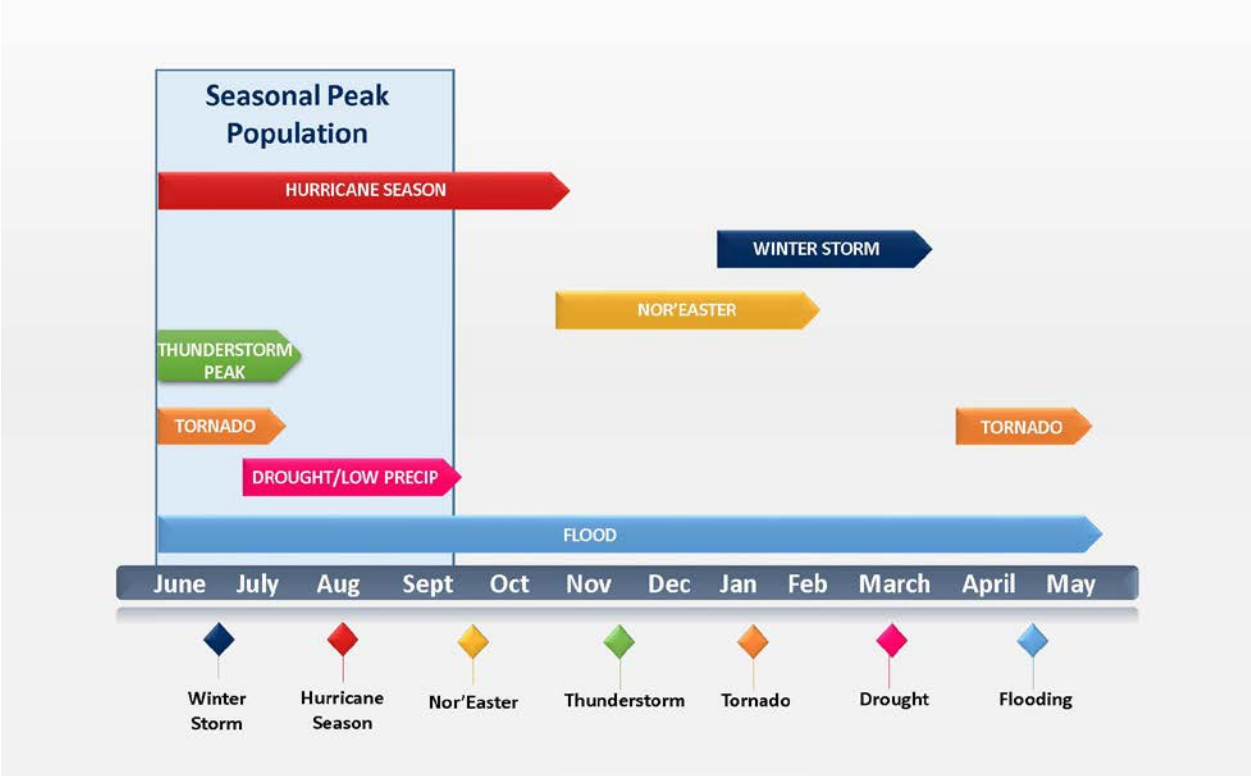
Source: U.S. Census Bureau, 2014

In a resort area like Ocean City, it is important to understand the demographics of the total population, including year-round residents and seasonal visitors, rather than only the permanent population. Projections indicate that Ocean City may experience a small increase in its population, requiring more residential units than are available, adequate transportation, and a myriad of other basic services to be increased. Emergency planning must also concentrate on the total population, especially its seasonality. Hurricane season coincides largely with the tourist season, and evacuation plans must take this into account. As population numbers increase through the years, it can be

expected that there will be no reduction in housing stock, thus, severe hazards will impact more and more homes with high dollar losses. Constructing newer more storm-resistant buildings naturally increases the building's value. Although they are less likely to suffer damage, they are more likely to cost more if damaged. Most locations in Ocean City are similarly prone to damage from most hazards, depending on the severity of that hazard. There are some locations that are slightly higher in elevation (1-3 feet) above sea level but not enough to avoid being affected by most hazards. Ocean City's flat terrain, narrowness, proximity to water, and insufficient drainage place nearly any structure in harm's way when conditions worsen**.**

Measuring the seasonal or total population is a difficult task for a resort community. Obviously, the summer has the highest populations. It is important to note that population of Ocean City fluctuates greatly seasonally which impacts evacuation planning and emergency services. As summer is the most populous season, coinciding with the peak of the hurricane season, evacuation plans must account for this seasonal population shifts. Furthermore, other hazards such as peak thunderstorm season and tornadoes must be considered in relation to the seasonal peak population.

Figure 1-2: Seasonal Peak Population & Natural Hazards



Source: Smith Planning and Design

1.3 Economy

Ocean City's economy is dominated by one industry, tourism. The tourism industry is comprised of three sectors: accommodations, food and beverage, and retail and services. A smaller economy exists to serve the needs of permanent residents and the

substantial number of off-season visitors, although many establishments do close for part of the off-season.

Table 1-2 list employment in Ocean City by industry. It is obvious that the classification that support tourism (retail trade and services) are the dominant employers.

Table 1-2: Employment by Industry – Ocean City Residents, 2014

Employment by Industry – Ocean City Residents, 2014	
Industry	**Number Employed**
Agriculture, Forestry, Fishing and Hunting, and Mining	0
Construction	206
Manufacturing	112
Arts, Entertainment, and Recreation	73
Other Services, Except Public Administration	74
Information	99
Transportation and Warehousing	70
Utilities	8
Educational-Healthcare and Social Assistance	525
Wholesale Trade	60
Retail Trade	474
Finance, Insurance, and Real Estate and Rental and Leasing	320
Professional, Scientific, Management, Administrative, and Waste Management Services	289
Public Administration	92
Total	**2,402**

*Source: U.S. Census, 2010-2014 American Community Survey 5-Year Estimate **

The table above reflects year round employment by industry for Ocean City. The number of employees are year round residents. This information does not reflect the tourism industry that is predominately seasonal. According to Table 1-2, the construction industry has substantially diminished over the past several years, causing fewer building permits and less revenue for the town. Permits for small additions, renovations, and demolitions have continued. According to the Town of Ocean City Comprehensive Annual Financial Report for ending 2014 FY, there were 1,564 building permits issued in 2014, compared to 1,660 in 2013. However, the estimated value of permits in 2014 was $51,755,670, compared to $36,287,285 in 2013. Several development projects were started in 2014 including two large hotels. Wastewater flow numbers (demoflush) indicate record numbers of visitors on weekends throughout the summer season. These figures are distributed at the beginning of each work week by the wastewater flow staff to all departments.

Rental units have had a few occupancy problems with the high visitation rates remaining steady. Foreign students are in high demand as local businesses hire them to keep shifts manned for long summer days. While some foreign students live in employer-owned businesses, there is still a deficit in employee housing. The town highly encourages employers to provide workforce housing at every opportunity.

An economic goal of Ocean City in recent years has sought to increase business with the use of festivals, entertainment, and sporting events. Such events include: Sunfest,

Winterfest of Lights, Springfest, the Ocean City Air Show, auto rallies, and motorcycle events. The Town of Ocean City also sponsors family events such as: movies on the beach, concerts, entertainment venues at Northside Park and Sunset Park. The growth of golf as an alternative recreational activity in the areas has strengthened the economy of the fall and spring months. There are nineteen golf course in the Ocean City area.

The advertising and promotional budgets have been increased to offset the effects of the national recession on the tourism industry. The budgets have increased from $3.7 million in 2009 to $6.3 million in 2014. Television ads, social media, Facebook and Twitter has been successful in promoting the resort. According to the Town of Ocean City Comprehensive Annual Financial Report for ending 2014 FY, for the year ended June 30, 2014, room sales were 3.54% above the prior year and food and beverage sales were up 4.13%. Over the past five years, room sales have increased an average of 4.27% per year.

Because the local economy is so dependent on and affected by the environment, hazard mitigation is a crucial undertaking. If damage from floods, hurricanes and other hazards can be minimized, the impact of these events on the economy can also be minimized. This is especially true in a seasonal economy. The economic damage caused by a hurricane striking during peak summer tourist season would be devastating when the major portion of business income is made in such a short time period. The more damage that can be avoided by proper planning and mitigation, the less the local economy will suffer. The Town of Ocean City updates its insurable property so that all are properly insured. The Risk Assessment staff are trained to investigate any liabilities and town-related damage or injury cases.

1.4 Development Trends

It is estimated that 95% to 98% of the land of Ocean City is developed, and this lack of vacant land dictates that future growth and development will consist primarily of redevelopment. This trend is going, with many older structures being razed and replaced with new, modern structures. Redevelopment such as this bodes well for the hazard resistance of structures in the future, because as older structures that may not have been built to current code requirements are removed and replaced with code compliant buildings, the new buildings will be less prone to damage. The town's codes serve as a primary means of mitigation, since they require, among other things, greater than minimum structure elevation, foundation requirements, and open space protection. The Ocean City of the future will be much better able to withstand all hazards, assuming strict enforcement of codes and new code adoption continues.

PLANNING SUPPORT

In October of 2015, S&S Planning and Design was contracted to update the *2011 Town of Ocean City, Maryland All-Hazard Mitigation Plan* and develop the *2016 Town of Ocean City Hazard Mitigation Plan.* S&S Planning and Design assisted in the plan development by:

- Identifying hazards, assessing vulnerabilities, and understanding significant risks;
- Facilitating planning team meetings, public involvement, and decision making activities; and
- Creating an organized and functional plan document, including maps or other graphics.

In addition, S&S Planning and Design assisted in the coordination, facilitation, and execution of the mitigation planning process for Ocean City by utilizing their community planning abilities to:

- Recognize the unique demographic, geographic, technical, and political considerations of each participating community.
- Demonstrate knowledge or experience with land use and community development.
- Understands all the applicable policies and regulations as they apply to the mitigation plan, including Federal law, FEMA guidance, and state and local ordinances.
- Recognize that community input and public participation are integral to any successful mitigation plan.
- Exhibit familiarity with emergency management and multi-hazard mitigation concepts.
- Provide past performance information and references.

S&S Planning and Design worked with local stakeholders and Ocean City staff and shared the same commitment to developing a plan to reduce risks from hazards in their community.

RESOURCES

Resources included in the 2016 Plan Update included:

- FEMA Hazard Mitigation Planning Guidebooks;
- State of Maryland Local Hazard Mitigation Guidance;
- MEMA Technical Assistance; and
- Participating 2016 Plan Development Agencies and Organizations:
    - Emergency Services;
    - Chief Building Official;
    - Convention Center;
    - Engineering;
    - Finance;
    - Fire Department;
    - Planning and Community Development;
    - Police Department;
    - Public Works;
    - Parks and Recreation; and
    - Tourism.

This page is intentionally blank.

Chapter 2 – Planning Team

HAZARD MITIGAITON PLANNING COMMITTEE

Ocean City Emergency Services obtained funding through the *FEMA Hazard Mitigation Grant Program* to assist in the update of the *2011 Town of Ocean City Maryland All-Hazards Mitigation Plan.* Emergency Services staff sought the assistance of the Planning and Community Development Department to identify key personnel and stakeholders. Invitations were distributed requesting participation and membership on the 2015-2016 Hazard Mitigation Planning Committee.

Committee membership is comprised of representatives from various departments within Ocean City government, volunteer fire and rescue departments, and community organizations.

Table 2-1: Ocean City, Maryland Hazard Mitigation Planning Committee

Hazard Mitigation Planning Committee Members	
Member Name	**Agency/Department**
Joe Theobald	Emergency Services
Bob Rhode	Emergency Services
Janet Guiton	Emergency Services
Ross Fowle	Emergency Services
Michael Collins	Emergency Services
Kevin R. Brown	Chief Building Official
Larry Noccolino	Convention Center
Terry McGean	Engineering
Dawn Leonard	Finance
Martha Bennett	Finance
James Deptula	Finance
Chuck Birely	Finance
Tim Price	Fire Department
Blaine Smith	Planning and Community Development
Karen Zera	Planning and Community Development
Bill Neville	Planning and Community Development
Scott Kirkpatrick	Police Department
Scott Harner	Police Department
Roger Steger	Public Works
Calvin Ginnavan	Parks and Recreation
Joe Perry	Parks and Recreation
Eric Lagstrom	Parks and Recreation
Donna Abbott	Tourism

Source: S&S Planning and Design & Ocean City Division of Emergency Services

A series of meetings were held throughout the Plan Update development process. S&S staff met with key Ocean City staff members to develop project schedule, obtain data, and review progress. In addition, three (3) HMPC meetings were held approximately every three (3) months during the update process.

Ocean City staff also attended the Maryland Regional and Resiliency Outreach meetings held in the spring of 2016. Furthermore, Ocean City staff attended several of the Worcester County hazard mitigation planning meetings to ensure plan integration, collaboration, and concurrence.

HMPC MEETING 1	21 July 2015 Reviewed Plan Update process and discussed hazard identification and ranking process.
HMPC MEETING 2	22 October 2015 Completed a "Work Session" identifying community capabilities, areas most vulnerable to flood hazard, 2011 mitigation strategies status update.
HMPC MEETING 3	February 2016 Reviewed risk assessment results and identified mitigation goals, objectives, and actions for inclusion into the 2016 Plan Update.

ADDITIONAL PLANNING SUPPORT

In addition to the contributions made by the Hazard Mitigation Planning Committee during the plan development process, the Local Emergency Planning Committee (LEPC) contributed. The LEPC added hazard mitigation planning topics to their quarterly meeting agendas throughout the plan development process. They will continue to be instrumental as the main committee through which the plan will be implemented and maintained. The LEPC is comprised of various stakeholders representing agencies, departments, organizations, and local businesses.

Chapter 3 – Outreach Strategy

OUTREACH STRATEGY

At the October 22, 2015 Ocean City Hazard Mitigation Planning Committee meeting, S&S and HMPC members discussed several potential public outreach projects. These projects provided valuable services by helping to generate messages and public information sharing throughout the mitigation planning process. The committee identified the following projects:

- City Council Briefing – March, 2015;
- Newsletter – Spring, 2015; and
- Website – Promoting Mitigation Plan.

It was the Ocean City HMPC's goal to evaluate and incorporate feedback received through the outreach activities and incorporate into the planning team's decision making process and the final plan. In addition, policies are in place for public review of the documents prior to adoption, which should be followed for the final comment period for the mitigation plan.

3.1 City Council Briefing

The Hazard Mitigation Plan document is reviewed by City Council members. The hazard mitigation plan briefing is held during city council meetings. Following plan review and public comment review period, the plan is formally adopted during a city council meeting.

3.2 Newsletter

S&S Planning & Design worked alongside, Bob Rhode and the Town's Public Information Officer to develop an article on the Hazard Mitigation Plan update. The article was inserted in the Ocean City Spring Newsletter.

Comprehensive Plan Underway

Employees of the Town of OC are busy making updates to the community-wide Comprehensive Plan and Hazard Mitigation Plan. The town's Planning & Zoning Commission is tasked with the responsibility for review and recommendation of changes to the community's Comprehensive Plan. The approved plan, dated August 2006, was updated in October 2009 but is currently due for a "six-year review." Review & discussion of Comprehensive Plan chapters is underway during regular meetings of the Planning and Zoning Commission, which occur at 6:30pm on the first and third Tuesday of each month at City Hall. For more information on the Comprehensive Plan, please visit oceancitymd.gov.

ALSO, HAZARD MITIGATION PLAN UNDERWAY

The town is also working on an update to the 2011 All-Hazard Mitigation Plan. Mitigation Planning is to identify local policies and actions that can be implemented over the long term to reduce risk and future losses from hazards. These mitigation policies and actions are identified based on an assessment of hazards, vulnerabilities, risks and participation of a wide range of stakeholders and the public in the planning process. A planning team has been established, which includes staff from multiple town departments. The Town of OC will make the completed updated plan available for public review and comment on the OC website this summer prior to public hearing. For questions or other feedback, or to find out how you can become involved, please contact the OC Emergency Management Office at 410.723.6616.

May 2016 through April 2017

OC Maryland

NEWSLETTER & COMMUNITY CALENDAR

May 2016-April 2017

800.OC.OCEAN | OCOCEAN.com | OceanCityMD.gov

What's Inside?

FRESH AIR, CLEAN BEACH.

Town Hires New City Manager

PERFORMING ARTS CENTER AMAZES

3.3 Preparedness Outreach

March 20-24: Flood Safety Awareness Week
All property in Ocean City is in a flood hazard area & subject to flooding from the ocean, coastal bays & heavy rainfall. Minor flooding is not uncommon & major flooding happens occasionally. FEMA places properties in flood zones based on their chance of flooding. Property owners can find their property's flood hazard designation by contacting the Department of Planning & Community Development, 410.289.8855, kbrown@oceancitymd.gov, or City Engineer, 410.289.8845, tmcgean@oceancitymd.gov.

May 11: Hurricane Preparedness Town Hall Meeting **City Hall Council Chambers, 6:30pm.** Public is encouraged to attend. Learn how we track storms, evacuation planning, shelters, individual/family preparedness planning, mitigation planning, and flood insurance. OC Emergency Mgmt. & Dept. of Planning & Community Development will be on-hand. ***410.723.6616, www.oceancitymd.gov***

Oct 6: Community Emergency Response Team (CERT) Program **65th St, 6:30pm.** CERT training is designed to help citizens help themselves & their families in the event of a catastrophic disaster. Due to the fact that emergency services personnel are not able to help everyone immediately following a disaster, CERT is a free training course that aims to provide citizens with basic preparedness info & techniques during emergencies. Training covers basic skills: CPR/AED, first aid, recognizing natural & manmade hazards in our local communities, disaster preparedness (emergency plans & disaster supply kits), hazardous material emergencies, and basic fire suppression. Help make a difference for your family & neighbors! *www.**oceancitymd.gov/oc/departments/emergency-services/***

3.4 Website

Ocean City, Maryland used their website to promote the hazard mitigation plan by providing a definition of hazard mitigation planning, a list of who is involved in the planning process, a description of how the plan update process works, and information about upcoming stakeholder meeting and opportunities for public involvement. Point of contact information was also provided for questions or comments. Downloads available from the site include copies of the existing plan, the plan update, public notices, and press releases: ***http://oceancitymd.gov/oc/departments/planning-community-development/.***

3.5 LEPC

Meets quarterly and will be utilized for Hazard Mitigation implementation and plan maintenance. The Local Emergency Planning Committee (LEPC) is comprised of various stakeholders representing agencies, departments, organizations, and local businesses.

Section 2 – Hazard Identification and Risk

TASK 4	Review Community Capabilities	Chapter 4-Community Capability
TASK 5	Conduct a Risk Assessment	Chapter 5-Hazard Identification & Risk Chapter 6-Coastal Hazards Chapter 7-Flood Chapter 8-High Wind Chapter 9-Winter Storm Chapter 10-Tornado Chapter 11-Thunderstorm

Section 2 – Hazard Identification and Risk begins with a review of the communities' current capabilities. These capabilities included planning and regulatory, administrative and technical, education and outreach, and financial. In addition to the Town's current capabilities, a Safe Growth Audit (SGA) was conducted. The SGA determines which current planning documents and mechanisms contain hazard mitigation and resiliency information, and identifies where there are opportunities for plan integration in future efforts. The SGA has been included in Appendix B, and serves as an additional reference to the Capability Assessment within this plan section.

A risk assessment was conducted and results of the assessment are included in Section 2, as well. Chapter 5 includes the hazards identified by the Hazard Mitigation Planning Committee and assessment of risk. Chapters 6-11 are hazard specific chapters. These chapters are consistently organized as follows: hazard profile, history, and vulnerability.

Chapter 4 – Community Capabilities

CAPABILITY ASSESSMENT

Each community has a unique set of capabilities, including authorities, policies, programs, staff, funding, and other resources available to accomplish mitigation and reduce long-term vulnerability. S&S staff reviewed the existing capabilities with the Ocean City planning team in order to identify capabilities that currently reduce disaster losses or could be used to reduce losses in the future. Worksheets were distributed to the HMPC committee members specific to four types of capabilities:

- Planning and Regulatory;
- Administrative and Technical;
- Education and Outreach; and
- Financial.

4.1 Planning and Regulatory

Planning and regulatory capabilities are the plans, policies, codes, and ordinances that prevent and reduce the impacts of hazards. Table 4-1, shows the most current Planning and Regulatory Capabilities for Ocean City, Maryland.

Table 4-1: Planning and Regulatory Capabilities

Plans	Yes/No Year	Does the plan address hazards? Does the plan identify projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?
Comprehensive/Master Plan	Y	2009 – Draft 2016
Capital Improvements Plan	Y	2014-2018
Economic Development Plan	Y	Eco Development Section /Refer to Worcester Plan
Comprehensive Emergency Operations Plan	Y	Updated 2013
Continuity of Operations Plan	Y	March 2016
Transportation Plan	Y	
Stormwater Management Plan	Y	Adopted Code State 2011
Community Wildfire Protection Plan	N	Not Applicable
Other special plans (e.g., brownfields, redevelopment, disaster recovery, coastal zone management, climate change adaptation)	Y	Coastal Bay CCMP 2015
Building Code, Permitting and Inspection	**Yes/No**	**Are codes adequately enforced?**
Building Code	Y	Version/Year: 2015 IC-State of Adoption
Fire department ISO rating	Y	Rating: 3
Site plan review requirements	Y	Required Task Code

Land Use Planning and Ordinances	Yes/No	Is the ordinance an effective measure for reducing hazard impacts? Is the ordinance adequately administered and enforced?
Zoning ordinance	Y	September 30, 2015 Updated
Subdivision ordinance	Y	September 30, 2015 Updated
Floodplain ordinance	Y	July 16, 2015
Flood insurance rate maps	Y	July, 2015
Acquisition of land for open space and public recreation uses	Y	Parks and Recreation Department
How can these capabilities be expanded and improved to reduce risk?		
The Ocean City Comprehensive Plan is undergoing an update in 2016-17. Information from the Hazard Mitigation Plan should be integrated into the City Comprehensive Plan Update. In addition, 2016 mitigation strategies should be reviewed in reference to other City planning documents, such as the Capital Improvement Plan and the Transportation Plan. As appropriate, mitigation strategies-actions and projects should be incorporated into City planning documents and ordinance updates, as a matter of standard operation procedure for updating planning documents. In addition, amend Zoning Ordinance to include the new FEMA DFIRM within Chapter 38-FLOODS, Article II, Section 38-31 –Definitions and rules of construction. Finally, replace flood zone language within ordinance to reflect July 2015 FEMA DFIRM.		

Source: S&S Planning & Design and Ocean City HMPC

4.2 Administrative and Technical

Administrative and technical capabilities were identified for Ocean City, Maryland. These include staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions. For smaller jurisdictions without local staff resources, if there are public resources at the next higher level of government that can provide technical assistance, they are noted as such. Table 4-2 indicates the Administrative and Technical Capabilities for Ocean City, Maryland.

Table 4-2: Administrative and Technical Capabilities

Administration	Yes/No	Describe Capability. Is coordination effective?
Planning Commission	Y	Advisory Committee that Mostly Reviews and Approves Building Plans/Projects
Mitigation Planning Committee	Y	Hazard Mitigation Planning Committee – Table 2-1
Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems)	Y	Public Works and Parks & Recreation are Proactive
Mutual aid agreements	Y	Primarily Public Safety & Public Works
Staff	**Yes/No Full/Part Time**	**Is staffing adequate to enforce regulations? Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective?**
Chief Building Official	Y	Certified & Attends Regular Trainings & Workshops
Floodplain Administrator	Y	Certified & Attends Regular Trainings & Workshops
Emergency Manager	Y	
Community Planner	Y	
Civil Engineer	Y	

GIS Coordinator	Y	
Other: Grant Writer	Y	Have a Dedicated Grant Coordinator
Technical	**Yes/No**	**Describe capability. Has capability been used to assess/mitigate risk in the past?**
Warning systems/services (Reverse 911, outdoor warning signals)	Y	Electronic Signage, Red Alert (Reverse 911)
Hazard data and information	Y	Information Available but Accessing Limited (Technology & Training)
Grant writing/Reporting	Y	Dedicated Staff
Hazus analysis	N	Will be completed as part of the 2017 Hazard Mitigation Plan Update process.
How can these capabilities be expanded and improved to reduce risk?		
Continue to ensure that the hazard mitigation planning committee meets regularly. Continue to review risk assessment results and prioritize City projects that reduce risk and vulnerability.		

Source: S&S Planning & Design and Ocean City HMPC

4.3 Education and Outreach

Education and outreach programs, including methods already in place that could be used to implement mitigation activities and communicate hazard-related information were identified. Identified Education and Outreach Capabilities for Ocean City, Maryland are listed in Table 4-3.

Table 4-3: Education and Outreach Capabilities

Program/Organization	Yes/No	Describe program/organization and how relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	Y	Ocean City CERT Team Local LEPC DWP has RMP Monthly
Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)	Y	Ocean City Fire Department Ocean City Police Department Ocean City Emergency Management Community Emergency Response Team http://oceancitymd.gov/oc/departments/emergency-services/emergency-management/
Natural disaster or safety related school programs	Y	One School Handled by OCFD Worcester Sheriff Worcester County OEM
StormReady Certification	Y	Current 2016
Public-private partnership initiatives addressing disaster-related issues	Y	LEPC OEM MD State VOED Hotel & Motel

		Delmarva Condo Assoc. Montego & Caine Woods Assoc.
Other		Town/Department Website Government Cable Channels Two FM Radio Stations – 99.5 WPSB & 100.3 WWOP Gov. Delivery System
How can these capabilities be expanded and improved to reduce risk?		
In order to assist in the implementation of future mitigation activities: • Expand outreach efforts to include Facebook and Twitter; • Prioritize outreach efforts that include Community Rating System, flood mitigation and preparedness projects.		

Source: S&S Planning & Design and Ocean City HMPC

4.4 Financial

HMPC assessed whether Ocean City has access to or is eligible to use the following funding resources for hazard mitigation. Identified Financial Capabilities for Ocean City, Maryland are provided in Table 4-4 below.

Table 4-4: Financial Capabilities

Funding Resource	Access/ Eligibility (Yes/No)	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital improvements project funding	Y	Projects within the City Capital Improvement Budget
Authority to levy taxes for specific purposes	Y	
Fees for water, sewer, gas, or electric services	Y	Also, have Fees for Mitigation for New Construction
Impact fees for new development	Y	No, Limited to Utility Capacity & Infrastructure
Storm water utility fee	N	Do Not Recommend
Incur debt through general obligation bonds and/or special tax bonds	Y	Go Bonds
Community Development Block Grant	N	However, CDBG may be used as non-Federal match for HMA grant programs, if available
Other federal funding programs	Y	FTA Transportation, FAA, FEMA, U.S. Justice, U.S. Army Corps of Engineers
State funding programs	Y	
Other		See Appendix D – Hazard Mitigation Funding
How can these capabilities be expanded and improved to reduce risk?		
2016 mitigation strategies should be reviewed in reference to the Capital Improvement Plan for integration purposes. Projects that reduce risk and vulnerability to the citizens of Ocean City should be given prioritization. Resources that maybe used to fund future mitigation actions include: • Targeted funding within Capital Improvement budget. • CDBG funds as non-Federal match, which will offset local match requirements.		

Source: S&S Planning & Design and Ocean City HMPC

Chapter 5 – Hazard Identification & Risk

HAZARD IDENTIFICATION

State of Maryland Local Mitigation Plan Guidance published in May 2015 provides a hazard identification minimum standard. Utilizing Federal Disaster Declaration information for the State, the following hazards should be included in local mitigation plans:

- **Flood-** Flooding can be categorized as **flash,** riverine and coastal in Maryland. Flash flooding results from a combination of rainfall intensity and duration, and is further influenced by local topography and the ground's capacity to hold water. Riverine flooding is caused by persistent moderate or heavy rain over one or more days, sometimes combined with snowmelt, causing a river to slowly rise and overflow its banks. **Coastal flooding** occurs when normally dry, low-lying land is flooded by sea water. The extent of coastal flooding is a function of the elevation inland flood waters penetrate which is controlled by the topography of the coastal land exposed to flooding.

- **Coastal Hazards-** Coastal hazards take many forms ranging from storm systems like **tropical storms, hurricanes and Nor'easters** that can cause storm surge inundation, heavy precipitation that may lead to flash flooding, and exacerbation of **shoreline erosion** to longer term hazards such as **sea level rise.** Therefore, coastal hazards are to include, if applicable, **coastal storms, storm surge, hurricane, tropical storm, Nor'easter, sea level rise and shoreline erosion.**

- **Winter Storm-** Winter weather can take many forms including **snow, freezing rain, sleet and extreme cold** that may occur singly or in combination. Some of the most significant winter storms that affect Maryland are known as **"Nor'easters"** because they are accompanied by strong northeast winds.

- **Tornado-** A tornado is a violently rotating funnel-shaped column of air that extends from a thunderstorm cloud toward the ground. Tornadoes can touch the ground with winds of over 300 mph. While relatively short-lived, tornadoes are intensely focused and are one of nature's most violent storms.

- **Wind-** Wind is the motion of air past a given point caused by a difference in pressure from one place to another. The effects can include blowing debris, interruptions in elevated power and communications utilities and intensified effects of winter weather. Two basic types of damaging wind events other than tropical systems affect Maryland: **synoptic-scale winds and thunderstorm winds**. Synoptic-scale winds are high winds that occur typically with cold frontal passages or Nor'easters. Downbursts cause the high winds in a thunderstorm.

5.1 State Perspective

The Ocean City Hazard Identification & Risk results, shown on Table 5.1, encompasses the five hazards that must be identified in Maryland local hazard mitigation plan documents. The table below displays the relationship between the five broad Maryland identified hazards and the hazards identified and ranked by the Ocean City HMPC.

Table 5-1: Maryland Hazards & Ocean City Hazard Mitigation Planning Committee Analysis

Maryland Hazards	Ocean City Identified Hazards	Ocean City Risk Ranking
Flood	Coastal flooding	High
	Flash Flood	Medium
Coastal Hazards	Hurricanes/Tropical Storms	High
	Nor'easter	High
	Shoreline Erosion	Medium High
	Sea Level Rise	Medium High
Winter Storms	Winter Storm	Medium
Tornado	Tornado	Medium Low
Wind	High Wind	Medium High

Source: Ocean City, Maryland – 2016 Hazard Mitigation Planning Committee

5.2 Ocean City Hazard Identification & Risk

The hazard identification process for Ocean City, Maryland involved examining various types of hazards that have effected Ocean City in the past and collecting new information from 2011 to the present. Since it is assumed that hazards experienced by Ocean City in the past may be experienced in the future, the hazard identification process includes a history and an analysis of various hazards, their occurrences, and future probability.

During the preparation of the update to the Ocean City, Maryland Hazard Mitigation Plan, one of the initial tasks of the Hazard Mitigation Planning Committee was to perform a Hazard Identification and Risk Exercise. This hazard analysis was based upon committee member's individual agency and/or community perspective. Hazards that were ranked "**High**" or "**Medium High**" during this assessment process included: **Coastal Flooding, Hurricane/Tropical Storm, Nor'easter, Shoreline Erosion, Sea Level Rise, and High Wind**. Results of this assessment are presented in Table 5-2.

Table 5-2: Summary of Risk by Ocean City, Maryland Hazard Mitigation Planning Committee Analysis, 2015 Ranking

HAZARD	*High*	*Medium High*	*Medium*	*Medium Low*	*Low*
Flash Flood			X		
Coastal Flooding	X				
Hurricane/Tropical Storm	X				
Nor'easter	X				
Shoreline Erosion		X			
Sea Level Rise		X			
Winter Storm			X		
High Wind		X			
Tornado				X	
Extreme Heat				X	
Thunderstorm (Lightning & Hail)			X		

Source: Ocean City, Maryland – 2016 Hazard Mitigation Planning Committee

5.3 Probability & Impact

The information obtained from available hazard event data pertaining to frequency and probability of future events, their impact, and factors that may affect severity were analyzed. This assessment of probability and impact results in the determination of a composite risk score for each hazard identified, as shown in Table 5-3 below.

Table 5-3: Composite Score

HAZARD	Events/ Year Risk Rating	Impact Rating	Composite Score
Flood	3	5	**8**
Coastal Hazards	2	5	**7**
Tornado	1	5	**6**
Winter Storm	3	3	**6**
High Wind	5	3	**8**

Source: NCDC Data

***Events/Year Risk Rating**
The events per year risk rating was determined by calculating the average number of occurrences in Ocean City per year and assigning the corresponding risk rating as follows:
0-0.49 events per year = 1
0.5-0.99 events per year = 2
1.0-1.49 events per year = 3
1.5-1.99 events per year = 4
2.0 + events per year = 5

***Impact Rating**
The impact rating was determined by the potential damage and losses that would result from each hazard event.
1 = Low Impact
3 = Medium Impact
5 = High Impact
*****Composite Scores: 7-10 High; 5-6 Medium; 1-4 Low*****

Based on the hazard history and hazard profiles the aforementioned hazards have been ranked as low, medium, or high priority. The hazards that have a high frequency of occurrence and have caused significant damage to the area will be assessed in the following chapters as a part of Ocean City's Hazard Vulnerability Analysis.

5.4 Hazards Ranked HIGH by 2016 HMPC

During the 2017 HMP update, high hazards ranked by the HMPC are **Flooding** (Coastal Flood & Flash Flood)**, Coastal Hazards** (Hurricane/Tropical Storms, Nor'easter, Shoreline Erosion, Sea Level)**, and High Wind.**

5.5 Risk & Vulnerability Assessment Overview

During the *2017 Ocean City, Maryland Hazard Mitigation Plan update*, four major steps in developing a risk assessment were completed during the revision process:

1. ***Hazard Identification & Risk-Completed in Chapter 5;***

Chapters 6-11 are hazard specific chapters; steps 2-4 listed below are completed for each hazard chapter.

2. **Hazard Profiles;**
3. **Vulnerability Assessment; and**
4. **Loss Estimation**.

Chapter 6 – Coastal Hazards

COASTAL HAZARDS

Coastal hazards take many forms ranging from storm systems like **tropical storms, hurricanes and Nor'easters** that can cause storm surge inundation, heavy precipitation that may lead to flash flooding, and exacerbation of **shoreline erosion** to long-term hazards such as **sea level rise.** Therefore, coastal hazards are to include: **coastal storms, storm surge, hurricane, tropical storm, Nor'easter, sea level rise and shoreline erosion.** Profile, history, and vulnerability information for each type of coastal hazard is presented in this chapter.

In order to assess vulnerability for the various types of hazards, different vulnerability models were utilized. The vulnerability model utilized is dependent upon the hazard under assessment. For instance, hurricane vulnerability is assessed using the FEMA Hazus Hurricane model commonly referred to as Hurricane Wind Model. In Chapter 7 – Flood, coastal flooding vulnerability is assessed using the FEMA Hazus Flood model. The flood model assesses coastal flood losses for the 1-percent-annual-chance flood event.

6.1 Hurricane and Tropical Storm Profile

Hurricane, tropical storm, and tropical depression are all examples of a tropical cyclone. The categories and associated characteristics are as follows:

- Hurricane: maximum sustained surface wind speed exceeds 73 mph;
- Tropical Storm: maximum sustained surface wind speed from 39-73 mph; and
- Tropical Depression: maximum sustained wind speed is less than 38 mph.

Tropical cyclones, a general term for tropical storms and hurricanes, are low pressure systems that usually form over the tropics, referred to as "cyclones" due to their rotation. Tropical cyclones are among the most powerful and destructive meteorological systems on earth. In terms of impact, high winds, heavy rain, lightning, tornados, hail, and storm surge are all associated with tropical cyclones. In addition, as tropical cyclones move inland, they can cause severe flooding, downed trees and power lines, and structural damage.

Hurricanes are rated for intensity by using the Saffir-Simpson Scale, which provides an estimate of the potential damage that a hurricane may cause. This scale is based upon both wind speed and surface pressure. Scale categories range from category one to five, with category one having winds from 74-95 mph and pressure greater than 980 mb, while a category five hurricane may have winds in excess of 157 mph and pressure of less than 920 mb. The table below depicts the five categories of hurricane strength.

Table 6-1: Saffir-Simpson Hurricane Wind Scale

Saffir-Simpson Hurricane Wind Scale	
Category Wind Speed	**Effects**
Category 1 74-95 mph	Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, and vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
Category 2 96-110 mph	Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
Category 3-Major 111-129 mph	Devastating damage will occur: Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
Category 4-Major 130-156 mph	Catastrophic damage will occur: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possible months. Most of the area will be uninhabitable for weeks or months.
Category 5-Major >157 mph	Catastrophic damage will occur: A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Source: National Hurricane Center, 2012

6.1.1 Tropical Storm History (1998-2016)

Table 6-2: Coastal Flooding Events (1998-2016)

Date	Event Narrative	Property Damage
January 27 to 28, 1998	A Nor'easter battered the Lower Maryland Eastern Shore on Tuesday, January 27th and Wednesday, January 28th. The slow movement of the storm combined with the highest astronomical tides of the month resulted in an extended period of gale to storm force onshore winds which drove tides to an estimated 8.0-8.5 feet above MLLW at Ocean City. These tide levels resulted in moderate coastal flooding throughout the Lower Maryland Eastern Shore. The rainfall combined with the gale and storm force winds resulted in scattered tree limbs downed across much of the area. Numerous homes, several buildings and one hotel sustained damage in the Ocean City area. Assateague State Park also received significant damage. In addition, there were widely scattered power outages.	1.5M
February 4 to 6, 1998	A Nor'easter battered the Lower Maryland Eastern Shore from Tuesday, February 3rd through Thursday, February 5th. The slow movement of the storm resulted in an extended period of gale to storm force onshore winds which drove tides to an estimated 8.5 feet above MLLW at Ocean City. These tide levels resulted in moderate to severe coastal flooding throughout the Lower Maryland Eastern Shore. The south end of Ocean City, from 15th street to the inlet, received significant street flooding and flooding of homes. Significant beach erosion occurred in Ocean City, with major dune and beach damage experienced in Assateague Island. In addition, there were widely scattered power outages.	1.5M
May 12, 2008	Coastal flooding at times of high tide contributed to several roads, including parts of Coastal Highway in Ocean City, being closed. Police closed the Inlet parking lot due to flooding. Also, coastal flooding resulted in a sailboat rising to street level near Edgewater Avenue and 11th Street, as the Isle of Wight Bay overtook the shoreline.	25K

Date	Event Narrative	Property Damage
November 12 to 14, 2009	The peak tide height at Ocean City was 5.44 feet above MLLW, which was 3.17 feet above the astronomical tide. Numerous streets, homes and businesses were flooded in low lying areas of the county close or directly exposed to the Atlantic Ocean. Ocean City reported a major loss of the beach. The Corps of Engineers and the Ocean City Engineer estimated 1 million cubic yards of sand were lost, and approximately 50 percent of the Dune Line was lost. In addition, there was considerable damage to the beaches on Assateague National Seashore. More than 1500 tires from an offshore artificial reef washed up on to Assateague's beaches.	1M
October 28 to October 30, 2012	Tropical Cyclone Sandy moving northward well off the Mid Atlantic Coast then northwest into extreme southern New Jersey produced very strong northeast winds followed by very strong west or northwest winds. The very strong winds caused moderate to severe coastal flooding across portions of the Lower Maryland Eastern Shore. Water levels reached 3.0 feet to 4.5 feet above normal adjacent to the Atlantic Ocean resulting in moderate to severe coastal flooding. Ocean City Inlet reached a tide height of 6.06 feet MLLW. Numerous streets were closed due to flooding in the southern half of Ocean City. Portions of the fishing pier and boardwalk were damaged/destroyed by the combination of storm surge and extreme wave action. Severe beach erosion occurred from Ocean City southward to Assateague Island, with several areas of beach on Assateague Island breached.	2.50M

Source: NWS, NCDC (NOAA)

Table 6-2 provides data from the National Weather Service (NWS), National Climatic Data Center (NCDC) that listed a total of five (5) coastal flooding event affecting Ocean City, Maryland between 1998 and 2012. According to the data, Ocean City, Maryland experienced one event during the 2011-2016 planning cycle.

6.1.2 Hurricane History (1996-2016)

Table 6-3: Hurricane Events (1996-2016)

Date	Event Narrative	Property Damage
July 13, 1996	Hurricane Bertha moved across the Lower Maryland Eastern Shore on July 13th. Spiral bands around the northern and eastern side of the storm affected the Lower Maryland Eastern Shore during Saturday morning. The highest sustained wind speed recorded was 23 mph at Salisbury, but the Fenwick Island Buoy, which is just offshore along the Delaware-Maryland border, recorded a sustained wind speed of 47 mph. The highest gusts recorded were 63 mph at Ocean City, and 55 mph at the Fenwick Island Buoy. One confirmed tornado was spawned by the hurricane near Madison in Dorchester county. Numerous trees and power lines blown down resulted in scattered property damage and power outages. Rainfall amounts generally ranged from 3.0 to 5.0 inches and caused some street flooding. The lowest sea level pressure recorded was 995 mb at Salisbury.	100K
September 15 to 16, 1999	Hurricane Floyd was a Category 1 hurricane as it crossed the Wakefield WFO county warning area. Tropical storm force wind gusts occurred over the northwest quadrant of the storm over portions of the Lower Maryland Eastern Shore. The highest sustained wind speed recorded was 36 mph at Ocean City Maryland (OXB). The highest sustained wind speed recorded at Salisbury (SBY) was 32 mph. The highest gusts recorded were 52 mph at Ocean City, and 48 mph at Salisbury.	5K

	Few trees and power lines were blown down across the Lower Maryland Eastern Shore resulting in scattered power outages. Storm surge flooding of 5 to 7 feet occurred over central portions of the Chesapeake Bay inundating sections of Dorchester and Somerset counties. Five feet of water flooded portions of Crisfield in Somerset county. Rainfall amounts generally ranged from 3 to 6 inches across much of the Lower Maryland Eastern Shore and caused some crop damage and street flooding. The lowest sea level pressure recorded was 976.8 mb at Ocean City (OXB).	
August 27 to August 28, 2011	Hurricane Irene moving northward over the outer banks of North Carolina and just off the Virginia and Maryland coasts produced tropical storm force winds across portions of the Lower Maryland Eastern Shore from Saturday morning, August 27th into Sunday morning, August 28th. Tropical storm force winds knocked down several trees and power lines, as well as, caused some substantial property damage. The highest sustained wind of 33 knots (38 mph) with a peak gust of 47 knots (54mph) was recorded at Ocean City Inlet. Coastal storm tides of 3 to 3.5 feet above astronomical tide levels were common. The tide level at Ocean City reached 4.68 feet MLLW. Storm total rainfall generally ranged from five to ten inches.	100K
September 2 to September 5, 2016	Rain bands associated with Tropical Storm Hermine produced generally 0.5 inch to 2 inches of rainfall across the county. Ocean City Golf Club (1 S) reported 1.97 inches of rain. Ocean City Municipal Airport (OXB) reported 0.76 inch of rain. Wind gust of 37 knots was measured at Ocean City Municipal Airport (OXB). Coastal storm tides of 1 to 2 feet above astronomical tide levels were common, with only minor beach erosion reported. The maximum storm tide reached 3.85 feet MLLW at Ocean City Inlet, which resulted in very minor coastal flooding Saturday evening.	0

Source: NWS, NCDC (NOAA)

Table 6-3 provides data from the NWS, NCDC that listed a total of four (4) hurricane events affecting Ocean City, Maryland from 1996 to 2016.

According to the website, oceancitymd.gov, Ocean City experienced minimal effects from the passage of Hurricane Sandy. Damage assessment reports indicated some beach erosion, marginal debris and severe damage to the Ocean City Fishing Pier.

6.1.3 Hurricane Vulnerability-Wind

The FEMA Hazus Hurricane Model was utilized to conduct an Enhanced Hazus Analysis on Hurricane Wind. The Hurricane Model allows practitioners to estimate the economic and social losses from hurricane winds. The information provided by the model will assist state and local officials in evaluating, planning for, and mitigating the effects of hurricane winds. The Hurricane Model provides practitioners and policy makers with a tool to help reduce wind damage, reduce disaster payments, and make wise use of the nation's emergency management resources. Although the software offers users the opportunity to prepare comprehensive loss estimates, it should be recognized that, even with state-of-the-art techniques, uncertainties are inherent in any such estimation methodology. The next major hurricane to affect Ocean City may be quite different than any "scenario hurricane" anticipated as part of a hurricane loss

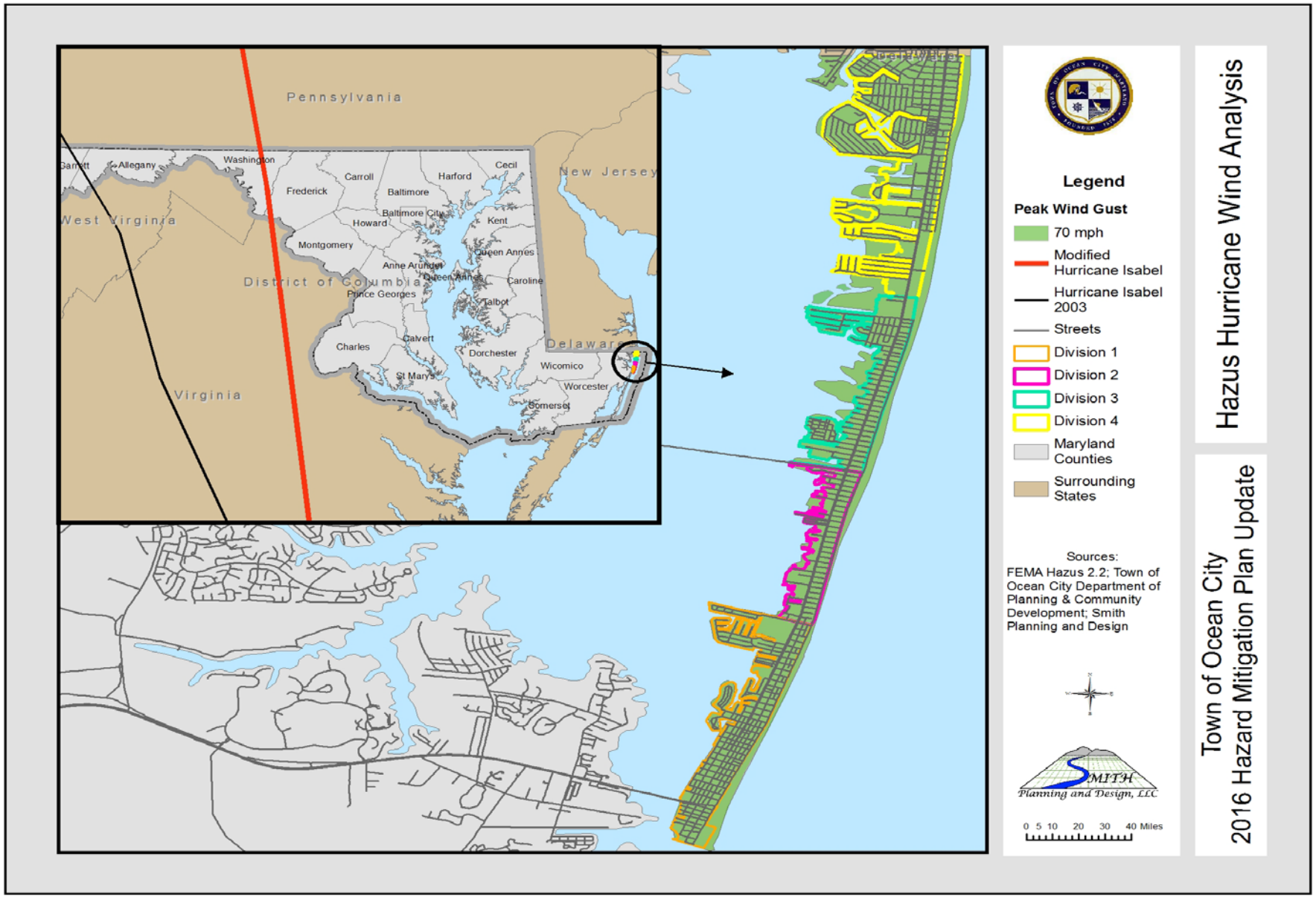
estimation study. Hence, the results of a scenario analysis should not be looked upon as a *prediction* but rather as an indication of what the future may hold.

Hazus provides different levels of analysis based on the level of effort and expertise employed by the user. Users can improve the accuracy of Hazus loss estimates by furnishing more detailed data about their community, or engineering expertise on the building inventory. An Enhanced Hazus analysis provides more accurate loss estimates due to the inclusion of detailed information on local hazard conditions and/or by replacing the national default inventories with more accurate local inventories of buildings, essential facilities and other infrastructure. The Enhanced Hazus Analysis, conducted by Smith Planning and Design, utilize integrated user-supplied data in order to yield more accurate loss estimates and risk assessments.

Input parameters were updated utilizing Ocean City GIS data, which was acquired from the Ocean City Department of Planning and Community Development. The geodatabase contained current parcel data for all critical facilities within the Town. The attribute tables attached to the shapefiles were edited to included additional and updated data to the existing tables. The additional and updated data was obtained from the 2012 Maryland Property View Database for Worcester County. Examples of data extracted from the 2012 Maryland Property View Database included: building stories, year built, structure value and square footage. The complete methodology for the Enhanced Hazus Analysis is located in Appendix E.

The Hurricane Wind – Enhanced Hazus Analysis, a historical storm analysis was initially modeled. In 2003, Hurricane Isabel impacted Maryland significantly and was Presidenital Declared a disaster on September 19, 2003. Hurricane Isabel tracked south and west of the state, causing moderate to severe damage. Along the Eastern Shore, the hurricane produces a storm surge peaking at 8 feet on the Chesapeake Bay side in Hoopers Island and 6.5 feet on the Atlantic coast in Ocean City. Due to the size of Hurricane Isabel, strong winds were generated across the area, including maximum sustained winds of 52 mph and a peak gust of 66 mph in Cambridge. Individual and public assisstance was provided in Ocean City. Considering Hurricane Isabel's severity of damage and impact, this storm was utilized as the base storm for the Huricane Wind – Enhanced Hazus Analysis. However, modifications to the storm track were made to increase the impact to Ocean City in the user defined storm analysis. These modifications included: alterations to the coordinates so the hurricane track was in closer proximity to Ocean City and the severity of the storm was increased from a Tropical Storm to a Category Two. Hurricane in excess of peak wind gusts for tropical storms are 55 mph, while the peak gust for the Category Two storm is 70 mph. Map 6-1 depicts the peak wind gusts and the historic Hurricane Isabel model along with the modified Hurricane Isabel used in the analysis.

Map 6-1: Hazus Hurricane Analysis –Hurricane Isabel Modified – Peak Wind Gust



6.1.4 Hurricane Loss Estimations

Ocean City's current building code for wind, adopted in 2015, is 100 mph. Structures built prior to the implementation of this code are most vulnerable to hurricane wind events. According to the enhanced Hazus analysis results for the modified hurricane wind event, no critical facilities would be affected by a storm of this magnitude.

Results for the Enhanced Hazus Analysis determined residential structures would be affected by the hurricane more so than other occupancy types such as commercial or industrial. Additionally, wood as a building material is more susceptible to damage than masonry, concrete or steel.

In terms of debris, the model estimates that a total of 895 tons of debris will be generated using the Hazus Modified Hurricane Wind Analysis. If debris tonnage is converted to an estimated number of truckloads, it will require 30 truckloads (@25 tons/truck) to remove the debris generated by the hurricane. In addition, 133 tons of debris is eligible tree debris, which could be chopped and/or chipped.

There are over 9,000 structures in the Town with an estimated replacement value of $2,752 million dollars. The economic loss for this event is $3.2 million with 98% of estimated losses comprised of residential.

Hazus Hurricane Wind estimates that approximately nine (9) residential structures would be moderately damaged due to wind during an event such as this and one (1) structure will be severely damaged. A total of eighty-eight (88) residential structures, four (4) commercial and one (1) industrial structures are expected to experience minor building damage; Appendix F – Hazus Hurricane Wind Report (page 6) details the total estimated loss specific to wind for Ocean City if a hurricane event of this magnitude occurred.

Table 6-4: Hazus Hurricane Analysis –Hurricane Isabel Modified – Building-Related Loss Estimations

Building Type	Loss Estimations
Residential	$2,847,830.00
Commercial	$64,960.00
Industrial	$2,020.00
Other	$7,420.00
Total	**$2,922,230.00**

Source: FEMA Hazus

6.1.5 Hurricane & Tropical Storm Conclusion

According to Hazus, no critical facilities would be affected by a storm of this magnitude since Ocean City's building code for wind is 100 mph. Two percent of the residential structures damaged are multi-dwelling structures consisting of 50+ units. However, structures built prior to the first edition of the International Building Code, published in 1997, may not be able to withstand strong winds and are therefore more susceptible to damage. Impact from power outage may affect the Beach Patrol Building, critical facility, that does not currently have a generator.

Critical facilities built prior to 1997 should be assessed for potential wind mitigation and are listed in Table 6-5.

Table 6-5: Critical Facilities Built Prior to 1997

Facility Name	Facility Address
EOC	6501 Coastal Highway
Airport	12724 Airport Road
Fire Station 2	102 Dorchester Street
Fire Station 1	1409 Philadelphia Avenue
Fire Station 3	7401 Coastal Highway
Tram Storage & Office- Whiteside	703 South Philadelphia Avenue
Beach Patrol/Tram/Comfort Station/North Boardwalk	2701 Atlantic Avenue
Keyser Yard/Life Saving Museum/Artifact Storage	10104 Keyser Point Road
Animal Shelter/Eagles Landing- Club House	12367 Eagles Nest Road
Comfort Station- 9th Street	900 Atlantic Avenue
Convention Center	4001 Coastal Highway
Tennis Center	6101 Coastal Highway
Northside Park- Parks Building	200 125th Street
City Hall	301 Baltimore Avenue
Water Plant- 15th Street	1400 St. Louis Avenue
Water Plant- 44th Street	104 44th Street
Wastewater Complex- Office Building	6405 Seabay Drive
Public Works Complex	204 65th Street
Water Pump Station- 100th Street	105 100th Street
Wastewater Pump Station # 7	101 Jamestown Road
Wastewater Pump Station # 8	13004 Sinepuxent Avenue
Water Plant -- Gorman Ave	201 137th Street
Radio Tower-- Gorman Ave	202A 136th Street
Wastewater Pump Station #9	718 Kelly Road
Sunset Room	200 42nd St. (Bayside)

Source: S&S Planning and Design and HMPC

6.2 Nor'easter Profile

According to the National Oceanic and Atmospheric Administration (NOAA), a Nor'easter is a cyclonic storm that moves along the east coast of North America. It's called "Nor'easter" because the winds over coastal areas blow from a northeasterly direction.

Nor'easters may occur any time of the year, but are most frequent and strongest between September and April. These storms usually develop between Georgia and New Jersey within 100 miles of the coastline and generally move north or northeastward.

Nor'easters typically become most intense near New England and the Canadian Maritime Provinces. In addition to heavy snow and rain, Nor'easters can bring gale force winds greater than 58 miles per hour. These storms can produce rough seas, coastal flooding and beach erosion.

The East Coast of North America provides an ideal breeding ground for Nor'easters. During winter, the polar jet stream transports cold Arctic air southward across the plains of Canada and the U.S., and eastward toward the Atlantic Ocean, as

warm air from the Gulf of Mexico and the Atlantic tries to move northward. The warm waters of the Gulf Stream help keep the coastal waters relatively mild during the winter, which in turn helps warm the cold winter air over the water. This difference in temperature between the warm air over the water and cold Arctic air over the land is the area where Nor'easters are born.

6.2.1 Nor'easter History (1998-2016)

During the 2011-2016 planning cycle, there were zero Nor'easter events recorded with NCDC. However, three events were recorded from 1998-2009. Total property damage reported 4 million.

Table 6-6: Nor'easter Events (1998-2016)

Date	Event Narrative	Property Damage
January 27 to January 28, 1998	A Nor'easter battered the Lower Maryland Eastern Shore on Tuesday, January 27th and Wednesday, January 28th. The slow movement of the storm combined with the highest astronomical tides of the month resulted in an extended period of gale to storm force onshore winds which drove tides to an estimated 8.0-8.5 feet above MLLW at Ocean City. These tide levels resulted in moderate coastal flooding throughout the Lower Maryland Eastern Shore. The rainfall combined with the gale and storm force winds resulted in scattered tree limbs downed across much of the area. Numerous homes, several building and one hotel sustained damage in the Ocean City area. Assateague State Park also received significant damage. In addition, there were widely scattered power outages.	1.5M
No crop damage or fatalities associated with this event.		
February 4 to February 6, 1998	A Nor'easter battered the Lower Maryland Eastern Shore from Tuesday, February 3rd through Thursday, February 5th. The slow movement of the storm resulted in an extended period of gale to storm force onshore winds which drove tides to an estimated 8.5 feet above MLLW at Ocean City. These tide levels resulted in moderate to severe coastal flooding throughout the Lower Maryland Eastern Shore. The south end of Ocean City, from 15th street to the inlet, received significant street flooding and flooding of homes. Significant beach erosion occurred in Ocean City, with major dune and beach damage experienced in Assateague Island. In addition, there were widely scattered power outages.	1.5M
No crop damage or fatalities associated with this event.		
November 12 to November 14, 2009	An intense Nor'easter produced moderate to severe coastal flooding across portions of the Lower Maryland Eastern Shore.	1M
No crop damage or fatalities associated with this event.		

Source: NWS, NCDC (NOAA)

The Nor'easter of 1962 produced a historic storm surge reportedly reaching 7.8 feet.

In 2015, prior to Hurricane Joaquin, a Nor'easter effected Ocean City. According to Storm Team4 and NBC Washington staff, the Nor'easter caused up to five feet of water to flood low-lying areas during high. The Nor'easter continually flooded the downtown area with rising tides causing street closures and power outages.

6.2.2 Nor'easter Conclusion

Although no recorded Nor'easter storms had affected Ocean City during the planning cycle, these types of storms can result in significant impacts such as property and infrastructure damage. As such, their probability of occurrence during any given year should be taken into consideration. Mitigation actions that can reduce or minimize the impacts due to Nor'easter storms need to be evaluated and considered in the planning process.

6.3 Shoreline Erosion Profile

Shoreline erosion is the process of the gradual wearing away of land masses, and occurs along coasts and rivers and streams. Although flood-related erosion is covered by flood insurance, this peril is not covered per se under the National Flood Insurance Program (NFIP). The mapping and regulatory standards of the NFIP do not currently address erosion, but Community Rating System (CRS) credit is given to communities that include this hazard in their regulations, planning, public information, hazard disclosure, and flood warning programs. Many states and communities have established setbacks and other requirements in areas subject to erosion.

Chapter 38-FLOODS, Article II, Section 38-31 of the Ocean City Zoning Ordinance includes a Dune Setback Line. This line is demarcated as 75 feet westward of the beach replenishment project line. The purpose of the dune setback line is "to protect the integrity of any naturally occurring or manmade dunes".

According to the Maryland Department of Natural Resources, erosion is a significant problem currently facing Maryland's diverse coastal environment. Approximately 31% of Maryland's coastline is currently experiencing erosion. Sea level rise is a causal force, which influences the on-going processes that drive erosion, in turn making coastal areas ever more vulnerable to both chronic erosion and episodic storm events (Nor'easters, tropical storms, hurricanes). Maryland is currently losing approximately 580 acres of land per year to shore erosion.

6.3.1 Shoreline Erosion History, Vulnerability & Sustainability

In 1994, the State of Maryland, Worcester County and Ocean City accepted responsibility for operation and maintenance of the completed Atlantic Coast of Maryland Storm Protection Project. The project consists of the Beach Renourishment program, dunes, dune crossovers, plantings and fencing along with the seawall along the boardwalk.

The State of Maryland, Worcester County, and Ocean City have a long term (50 year) written partnership agreement with the U.S. Army Corps of Engineers (USACE) to perform periodic beach renourishment as needed to maintain adequate storm protection. Per this agreement, the USACE designs and manages the needed renourishment dredging operations and pays for 53% of the cost of renourishment.

Maintaining the Project takes a tremendous amount of effort from local and state officials. Crews of Ocean City's Public Works Department maintain all the items mentioned above and the Office of Engineering keeps constant watch on the Project.

Emergency Beach Replenishment Project Expected in Ocean City

OCEAN CITY — The resort beach, still slowly recovering from the ravages of Hurricane Sandy last fall and other strong storms throughout the winter, will be getting a much needed boost after the Army Corps of Engineers this week released a pre-solicitation notice for an extensive re-nourishment project that will ultimately pump a million cubic yards of sand onto the barrier island. During Hurricane Sandy in late October, the Ocean City beaches took a huge hit with severe erosion and the destruction of much of the face of the extensive protective dune system. Some of the erosion has been corrected by natural processes over the course of the winter, but evidence of the storm still exists in many places, particularly in traditional narrow portions of the strand. Almost immediately after the storm passed, Army Corps of Engineers officials out of the Baltimore District arrived in Ocean City to assess the damage and began to make determinations about what action would be needed to restore the damaged beaches.

The key element of the upcoming project consists of using an offshore, ocean-going hopper to hydraulically dredge one million cubic yards of sand and pump it onto the Ocean City shoreline in response to the damage caused by Hurricane Sandy and for periodic shoreline maintenance. The sand is expected to be pumped from a designated borrow area roughly two to three miles off the coast of the resort and will be used to help replace the beach and the dune system.

The eventual contract will also include the reconstruction or repair of the vast dune system that stretches from the northern end of the Boardwalk to the Delaware line. Also included in the future contract is providing and planting of dune grass and providing and installing rope fencing.

It remains uncertain when the project will go out to bid and it appears unlikely the extensive replenishment project will be undertaken before the upcoming summer season. According to the Corps' pre-solicitation notice, the project will require a large amount of beach-fill in a relatively short window of time. The eventual contract duration will be approximately 210 days from start to finish and the wide cost range for the project is estimated at anywhere from $10 million to $25 million.

Source: The Dispatch-April 4, 2013 by DispatchAdmin

Installation of fencing, landscaping items, decks, planters, or any permanent item is prohibited east of the Construction Limit Line (CLL), which runs more or less parallel with the dunes and is located approximately ten (10') feet to the west of the westerly toe of the dunes. This area must be kept clear and open for easy access, maintenance and monitoring purposes. It can be easily located at your property by measuring back ten (10') feet from the sand fencing at the toe of the dune. The beach in Ocean City is Maryland's Project for everyone's enjoyment. It protects your property and life. To date the project has prevented and estimated $600 million dollars in storm damage.

Dune Stabilization

Millions enjoy the ocean beach for the water, sun, air and a multitude of sounds, sights and smells of nature. Dunes, formed by wind, water and vegetation are an integral part of the ocean environment and help protect the lives and property of coastal residents. Mankind is a main contributor to dune formation by pumping, constructing, fencing sand areas and establishing and maintaining vegetation.

The cooperative effort of local citizens and government produced a publication to help people in the Ocean City, Maryland area select and use plants to control erosion, build dunes, provide wildlife habitat and beautify the beach. It pictorially describes the types of plants, methods of establishing them and programs for maintaining a healthy, vigorous and functional vegetative community. It is in loose-leaf form to simplify the inclusion of alterations created by new technology or of new subject materials.

Dune Management

The beach at times appears as barren sand. Only specialized plants adapted to the inhospitable environment can survive and they must withstand salt, high heat, lack of nutrients, drought, flooding, erosion, abrasion from wind-driven sand and freezing temperatures.

A plant may be poisoned by salt, cooked by high temperatures, starved from lack of nutrients, withered from lack of water, cut by wind-driven sand, flooded by storm or tide, uprooted by wave or wind erosion, eaten by wild life or crushed by tourists. Most beach vegetation occurs naturally. However, man has introduced species such as yucca from the southwestern U.S. desert and lambs-quarters from Eurasia. Many species found on the beach are transitory and not suited to the long-term environment; others, such as downy broom and cheatgrass (a winter annual) can dominate the vegetative community temporarily, but may not reappear for years. Any vegetation growing on the beach helps stabilize the sand, and is therefore considered beneficial.

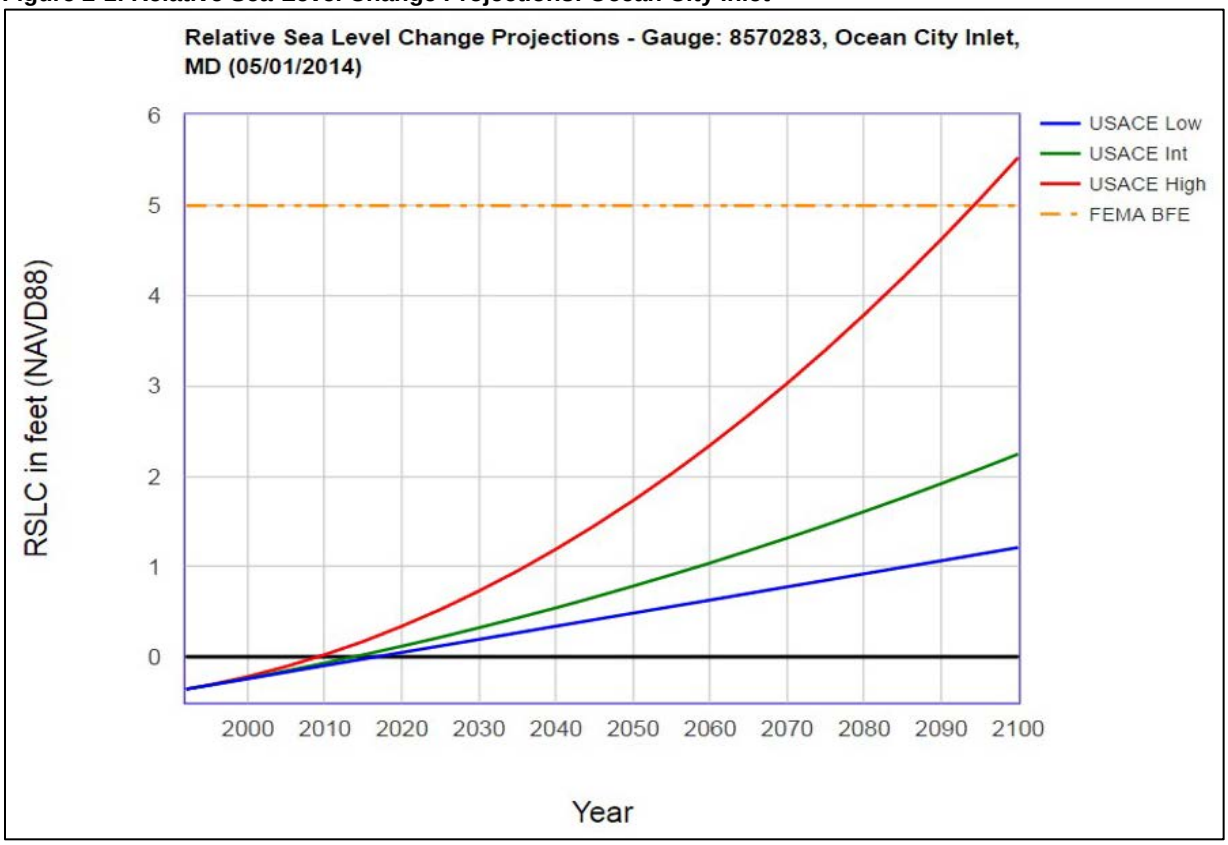
6.3.2 Shoreline Erosion Conclusion

Shoreline erosion is a hazard that can affect both structures and infrastructure. Mitigation actions such as the CLL have prevented additional impacts and losses. The dune management and stabilization programs, as well as the beach renourishment program, collectively minimize the impacts associated with shoreline erosion.

6.4 Sea Level Rise Profile

Ocean City, MD is vulnerable to elevated water levels from flooding, storm surge, and high tides due to its location on a developed barrier island along the mid-Atlantic coast. This sea level rise policy recognizes the importance of planning and preparing for the historic and future effect of changing sea level and how it may increase hazard risks to the community. Estimates of future conditions vary greatly depending on the source, the specific location and the period of time being examined. Ocean City relies primarily on the expertise of the U.S. Army Corps of Engineers (USACE) to identify the risk and adaptation measures necessary for this hazard mitigation element.

Figure 2-1: Relative Sea-Level Change Projections: Ocean City Inlet



Source: www.corpsclimate.us/ccaceslcurves.cfm)

The USACE establishes three projections for future sea level change beginning with an extension of historic sea-level rise rates. The USACE Low Curve is based on a 24-year regional rate of 0.01453 feet per year (1 foot in 69 years) for Ocean City, Maryland. Based on tide gauge data from the Ocean City Inlet (#8570283), the USACE Sea Level Change Curve Calculator also estimates an intermediate rate scenario of 0.0267 feet per year (1 foot in 37 years), and a high rate scenario of 0.0658 feet per year (1 foot in 15 years) that may be used for planning and project design.

6.4.1 Local Data

A report published by the Coastal Zone Management Division of the Maryland Department of Natural Resources, entitled A Sea Level Rise Response Strategy for the State of Maryland (October 2000), notes that sea level has risen approximately one foot in the past century in Maryland, nearly twice the global average. The report projected an average rise of two or more feet by the year 2100 statewide. Potential effects of this rise are anticipated to increase coastal flooding, submerge coastal wetlands, increase shoreline erosion, and cause additional structural damage to unprotected structures. Additionally, it will affect migratory waterfowl, seafood industry resources and other ecological and recreational resources that are important to the local economy.

Sea level rise rates are predicted to accelerate over time and are unique to each geographic location. Observation of this change is not easy when predictions are only a fraction of an inch per year. Significant changes are therefore projected much further into the future to be measurable. Although most references estimate long term risk for the year 2100, local government decision making typically evaluates risk factors in shorter increments:

Table 6-7: Sea Level Rise

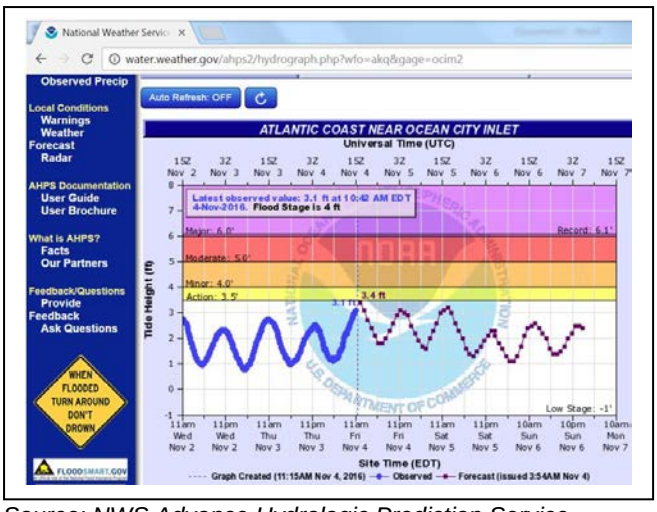
	Low	Intermediate	High
10 years (Capital Improvement Plan)	1.7”	3.2”	7.9”
30 years (Length of mortgage/Comprehensive Plan)	5.2”	9.6”	23.7”
50 years (Infrastructure lifespan/Grandchildren)	8.7”	16.0”	39.5”

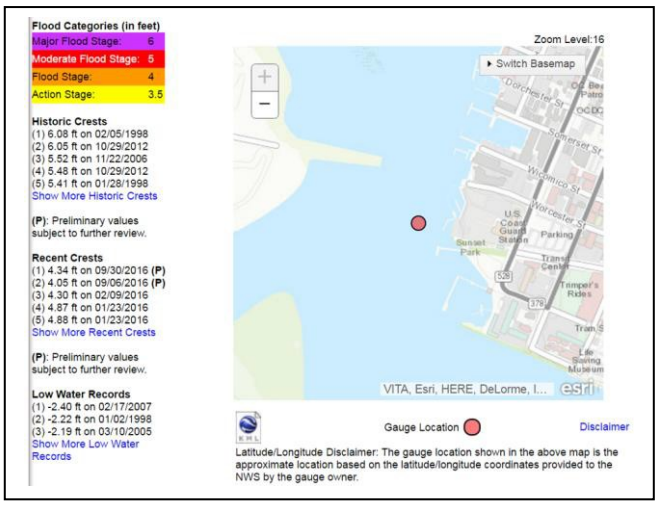
Source: USACE projections 2016

Planning documents such as the Hazard Mitigation Plan must be updated every 5 years which provides an opportunity to track indicators of change in sea level and verify long term projections.

Sea Level and Tide information is provided in real time by NOAA for the Ocean City, MD Inlet and is monitored by the Ocean City Engineering Department and Department of Emergency Services. Levels of historic flooding are also available to compare with the daily tide cycle and determine the time and duration of possible flood events.

Figure 2-2: NOAA Real Time Sea Level and Tide Information

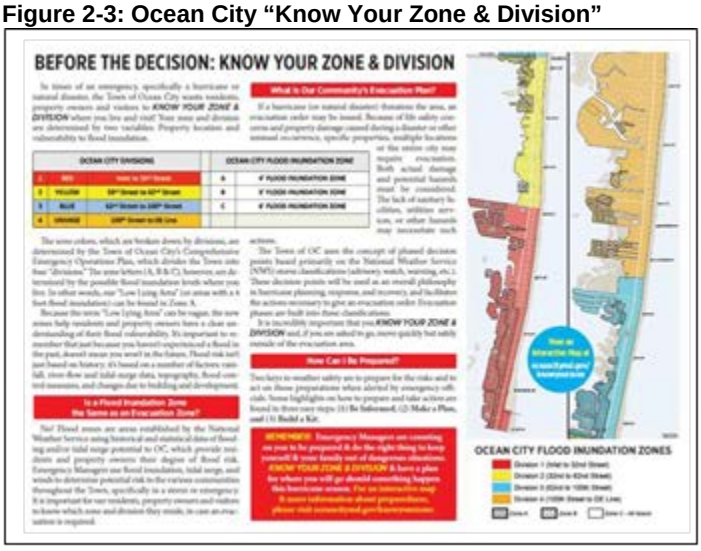




Source: NWS Advance Hydrologic Prediction Service

This information is coordinated with a public information program called “Know Your Zone & Division” including regular notifications on the Town website. Tracking changes in the frequency, duration and mapped limits of minor flooding at high tide is one method of verifying changes in sea level over time.

Figure 2-3: Ocean City “Know Your Zone & Division”



Source: http://oceancitymd.gov/oc/departments/emergency-services/emergency-management/know-your-zone/

The direct effect of storm events combined with long term sea level rise creates the increased potential for erosion of the ocean beach. Shoreline change along the Maryland Coast has been extensively studied by multiple federal agencies including the EPA, National Park Service and the United States Geological Survey. Active management by the USACE over the last 50 years has been successful in reducing the impacts of erosion through beach nourishment and dune construction during a period of historic or low rate of sea level rise.

Source: Ocean City - Beach renourishment 83rd Street

Existing barrier island profiles and the Ocean City Inlet have the effect of reducing storm surge and flooding impacts to the bayside shorelines of the community as evidenced by the Flood Insurance Rate Map (FIRM) mapping of 1% chance flood zones. Base flood elevations quickly change from 11 feet at the ocean beach to 5 feet near the US Coast Guard Station in downtown Ocean City.

Exhibit 6: FEMA Coastal Risk Map – July 16, 2015

Source: Ocean City - Base Flood Elevations-Ocean City Inlet

Relative SLR rates also appear to be lower at Ocean City's mid-point location between the Delaware Bay and Chesapeake Bay estuaries, with less effect from land subsidence and upstream watershed impacts (FEMA Region III Coastal Storm Surge Study 2013). Tide gauge readings, storm surge studies and sea level rise projections from Lewes, DE and Norfolk, VA are not an acceptable substitute for location specific data from the Ocean City Inlet or other coastal barrier island measurements.

To the extent that there is a local delay in observable SLR impacts in Ocean City, it will allow for the study of best practices in other communities, preparation of action plans tied to measured changes, and implementation of resiliency strategies for significant climate related events.

6.4.2 Future Impacts

Scientific studies such as the Maryland Coastal Resiliency Assessment (March 2016) typically place Ocean City in a high vulnerability category for the effects of sea level rise. Length of ocean and bay shoreline (80.9 miles), value of built environment ($8.6 billion), and annual tourism industry sales ($1.4 billion in 2013) all work together to support a strategy for defending and adapting to sea level rise.

How would sea level rise (SLR) increase community risks? Physical impacts of sea level rise can be divided into five categories (EPA report 1985):

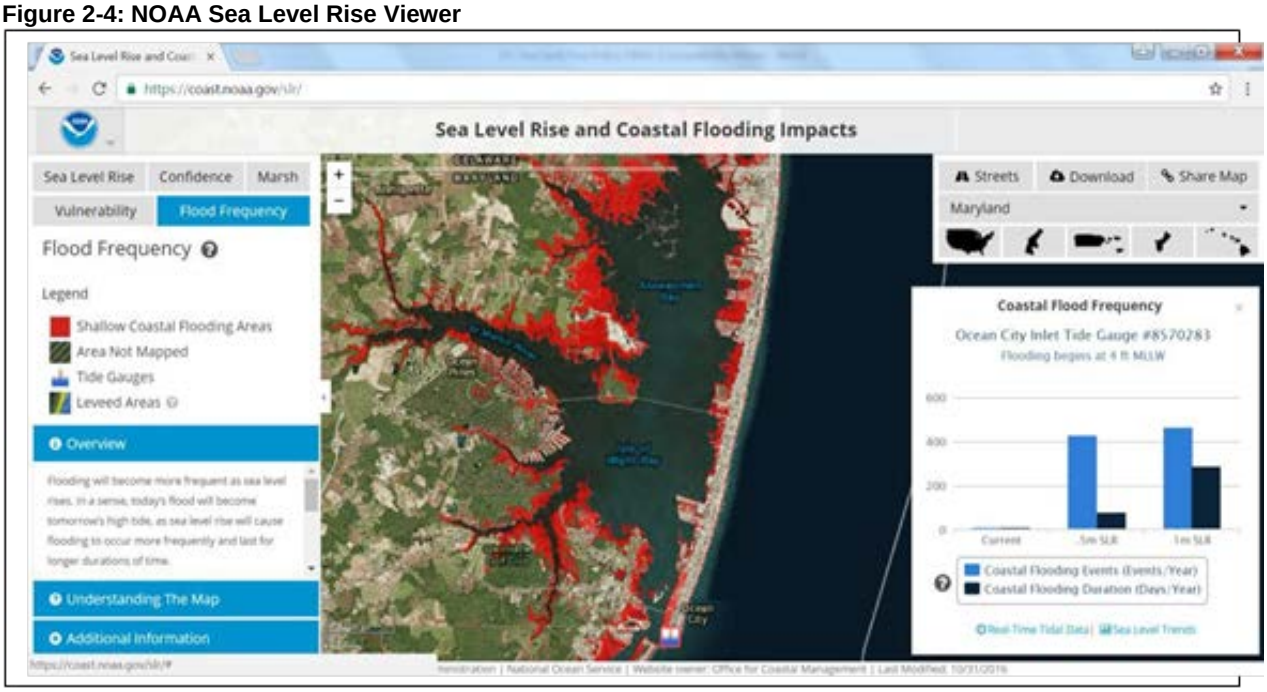
1. Inundation of low-lying areas;
2. Erosion of beaches, particularly along the ocean coast;
3. Increased flooding and storm damage to the built environment;
4. Salinity changes in surface and ground water; and
5. Higher water tables.

Economic impacts have been estimated in a Study of the Economic Effects of Shore Protection Projects in New Jersey, Delaware, and Maryland by NOAA and the USACE Institute for Water Resources (May 2012). Without the USACE beach renourishment projects in Maryland, tourism related impacts from increased beach erosion over five years would result in:

- Loss of 490,000 to 653,000 tourists;
- $464 to $619 million in lost tourist spending (direct and indirect);
- 3,100 to 4,200 in lost tourism-related jobs; and
- $28 to $38 million in lost state and local taxes.

NOAA provides an online SLR Viewer tool that may be useful in evaluating the potential extent of low areas which are subject to periodic flooding and future impact of higher sea level. Note: these computer models typically project sea level rise in 1 foot increments applied to the highest seasonal tide, and therefore do not indicate a daily occurrence or 24-hour duration of flooding impacts.

Figure 2-4: NOAA Sea Level Rise Viewer



Source: NOAA Sea Level Rise Viewer (1 foot, 2 feet, 3 feet)

In coordination with a sea level rise response strategy for Worcester County prepared in 2008, Ocean City has incorporated monitoring, public information and rapid response management strategies to address areas of Town which are the 'first to flood'. The Hazard Mitigation Plan now incorporates FEMA flood depth information based on the new Flood Insurance Rate Maps (adopted July 16, 2015) and more accurate ground elevation surveys which will be used to update previous studies and improve monitoring.

Additional research and resources are available through the USACE North Atlantic Coast Comprehensive Study (January 2015) which evaluated the impacts of Hurricane Sandy and collected best practices for resilient adaptation to increasing risk into a series of useful reports. (http://www.nad.usace.army.mil/CompStudy/)

6.4.3 Examples

Effects of Sea-Level rise in Ocean City could include:

- Increased beach erosion rates which exceed the USACE renourishment schedule;
- Increased potential for damage from ocean storm surge flooding;
- Higher water levels in the back bays, and increased bayside flooding;
- Higher water tables and forest cover/vegetation change;
- Reduced capacity of City storm drain systems and slower natural drainage from soils;
- Loss of tidal wetlands and critical habitat due to inundation;
- Road access limited during extreme high tides;
- Utility service restrictions; and
- Groundwater resources impacted by saltwater intrusion.

A regional evaluation of sea level rise and its potential effects can be found in a document titled:

Coastal Sensitivity to Sea-Level Rise: A Focus on the Mid-Atlantic Region, January 2009; Washington, DC, USA. (https://digital.library.unt.edu/ark:/67531/metadc12028/m2/1/high_res_d/sap4-%201-final-report-all.pdf)

6.4.4 Adaptation Measures

Ocean City has traditionally placed a high priority on storm readiness and protection of the community. The same measures taken to mitigate the impacts of a Category I storm event are generally considered to be the first steps in preparing for long term sea level rise. Public and private measures to decrease future loss from this hazard include shoreline protection, raising the level of local streets when major infrastructure improvements are scheduled, improving bulkheads, and constructing buildings at a higher elevation.

Strategies and management approaches in this plan are intended to mitigate storm damage to the community, and to protect critical infrastructure. Each storm event is unique, there are natural and economic limits to preparing for the highest projections of sea level rise, and it is not possible to avoid all damage or injury. Therefore, each property owner, resident and visitor is also expected to take responsible actions to protect life, property and the environment.

Table 6-8: Adaptation Measures

	Adaptation Measures	Description	Action
A	**Beach Nourishment**	Ocean City's primary response to beach erosion is sand replenishment, which elevates both the recreational portion of the beach and the offshore beach profile. This 50-year renourishment project, undertaken in partnership with the Army Corps of Engineers, State of Maryland, and Worcester County is designed to counteract erosion caused by sea level rise as well as other factors. The Atlantic Coast of Maryland Shoreline Protection Project relies on the continuation of federal and state funding through the year 2044.	Begin 5 years prior to the project end to complete new elevation/design which confirms and incorporates current SLR estimates, prepare new cost benefit analysis, confirm offshore sand resources, and work with the congressional delegation to reauthorize the USACE project (Atlantic Coast of Maryland Shoreline Protection).
B	**Sand Dune/Seawall System**	Increased beach erosion rates and ocean storm surge height were recognized and planned for by the Army Corps of Engineers during the design of the Shoreline Protection Project. Project design parameters and maintenance efforts will be modified as needed to mitigate for sea-level rise impacts during the life of the project.	The City will continue to monitor current sea level rise rates and the performance of the Shoreline Protection Project.
C	**Ocean City Inlet Maintenance**	USACE Operation and Maintenance funds are required on an annual basis for the Ocean City Inlet between the Atlantic Ocean and the Isle of Wight/ Sinepuxent Bays. This project provides adequate inlet channel width and depth for navigation access, and when necessary repairs inlet seawalls and jetties. The Inlet helps to control storm surge and flood levels between the Ocean and the Bay, and is critical to maintaining water quality and water temperature in the coastal bays.	Maintain Inlet Channel as an element of critical infrastructure and community resiliency. Evaluate necessary design changes and adaptations for sea level change or recurring storm damage.
D	**Assateague Island Restoration**	The Ocean City Inlet and jetties disrupt sediment transport along the coast with resulting erosion impacts on Assateague Island to the south. An ecosystem restoration project is underway through a partnership between the National Park Service and the USACE which includes long term inlet sand bypass with placement in the surf zone along the northern end of Assateague Island to stabilize this effect.	-Long term active management of the northern end of Assateague Island is required to prevent extreme overwash, the creation of additional inlets, and increased exposure of coastal communities to the effects of sea level rise and storm impacts. -Establish future management actions in the NPS General Management Plan and begin process to extend the long term project beyond its fiscal year 2028 end point.

	Adaptation Measures	Description	Action
E	**Floodplain Ordinance/ Building Code Administration**	Ocean City Floodplain Ordinance (Ch. 38) and Building Code (Ch. 10) recognizes the future effects of sea level rise by adopting increased building construction standards and freeboard elevation requirements. The code requires that minimum first floor building elevations be 2 feet above highest adjacent grade in the X-zones, or 3 feet above current published FEMA 100-year base flood elevations for most areas of the City. This "free board" will reduce property damage from sea level rise during the life of the structure.	City policy shall be to continue enforcing these Local and State code provisions.
F	**Stormwater Drainage/Street Elevation**	Although current City code provides for minimum elevations for structures, it does not require minimum elevations for the land itself. With scheduled street reconstruction, the City improves the size and capacity of storm drain systems where practical.	- Building sites to be elevated such that the site will properly drain to a public way (primarily streets and alleys) at a minimum slope of 1 inch in 10 feet. -Within the 'first to flood' areas of the City any proposal to elevate streets will not be considered unless all property owners elevate their lots to minimize increased drainage impact on the lowest lots. -City streets and storm drain systems scheduled for replacement shall be designed such that the minimum street elevation shall be above the expected 10-year storm surge event including the effects of sea level rise for the expected life of the project. -Develop prototype solutions that mitigate short term impacts of stormwater flooding including tide gate installation on selected storm system outfalls, permeable pavement areas to limit surface flow across the northbound lanes of Coastal Highway, and expanded use of water quality basins/rain gardens/infiltration landscape areas.

	Adaptation Measures	Description	Action
G	**Critical Infrastructure Protection**	Ocean City monitors areas subject to tidal flooding and advises the public of flood risk. A current inventory and assessment of all public buildings and facilities is now included with this HMP update so that the long term effects of sea level rise may be incorporated into municipal facility design in the 10-year, 30-year and 50-year time frames.	- Public Buildings and Facilities shall be elevated and/or protected to a minimum elevation including freeboard in accordance with City Code Chapter 38 - Floods. -Ramp downtown ocean block streets up to the Boardwalk in connection with adjacent development and as funding is available. -Coordinate with State and Federal agencies to monitor groundwater resources for possible saltwater intrusion.
H	**Shoreline Management – Private Bulkheads/Piers/ Docks**	Administration of shoreline permitting by the Ocean City Board of Port Wardens allows for continuous local monitoring of new construction and maintenance of private bulkheads and hardened shorelines that are essential for working and recreational waterfronts, and property protection in Ocean City.	With the assistance of State agencies, Ocean City will evaluate 10 year and 30 year standards for bulkhead replacement and property elevation so that shoreline protection measures adequately account for future effects of sea level rise.
I	**Wetland and Habitat Management**	The continuing efforts of the Maryland Coastal Bays program to protect and enhance the environment around Ocean City will help mitigate for adverse environmental impacts from sea level rise. These efforts include increased sand dune, wetland/salt marsh management, construction of new bayside marsh and seagrass areas, offshore reef system for fish habitat and coastal defense, and many other initiatives.	Ocean City will continue to participate in the Maryland Coastal Bays Program and associated Comprehensive Coastal Management Plan.
J	**Public Information**	Other sections of the Hazard Mitigation Plan summarize public outreach and education efforts in Ocean City which includes the 'Know Your Zone' program, Preparedness Training (CERT), and annual Newsletter outreach.	- Ocean City will develop a long term localized monitoring program for sea level rise impacts. Results of this study will be incorporated into regular 5 year updates of community planning documents and included in the ongoing public information strategies. - Continue to participate in the National Flood Insurance Program as a CRS community.
K	**Plan Integration**	Elements of the Hazard Mitigation Plan will be incorporated and referenced into the Ocean City, Maryland Comprehensive Plan, as well as other planning documents to better inform short term land use and property management decisions.	Incorporate new information into regular plan updates.

6.4.5 Summary

The Town of Ocean City, MD will emphasize preparations for coastal flooding and high tide events as the first step toward sea level rise adaptation. Observations of changing local conditions and consideration of best practices from other coastal communities will be our ongoing practice. Ocean City will continue to partner with the USACE as the best practical means of preparing for sea level rise and building community resiliency.

For the purpose of long range planning in 10-year, 30-year and 50-year timeframes, the Town of Ocean City will primarily refer to the Intermediate USACE sea level change projections along with annual local observations.

Chapter 7 – Flood

FLOOD

The National Weather Service defines coastal or tidal flooding as the inundation of land areas along the coast caused by waters over and above normal tidal action that may originate from the ocean front, back bays, sounds, or other bodies of water. Coastal/tidal flooding is typically the result of storm surge, wind-driven waves, and heavy rainfall produced by hurricanes and tropical storms during the summer and fall and Nor'easters during the winter and spring. Ocean City has a high risk of coastal/tidal flooding. Watches and warnings are routinely issued for this event throughout the year.

Urban flooding occurs where there has been development within floodplains. Urbanization increases the magnitude and frequency of flooding by increasing the magnitude and frequency of flooding by increasing impermeable surfaces, increasing the speed of drainage collection, and overwhelming sewer systems.

7.1 Flood Profile

Flood-prone areas are identified by FEMA on the Flood Insurance Rate Maps (FIRM). The FIRM for Ocean City was made effective July 2015. All property in Ocean City is at some level of risk and subject to flooding from the ocean, coastal bays, and heavy rain fall. The 2015 FIRM maps establish new base flood elevations which are used to estimated flood risk and to guide development activity. Along the ocean front, the coastal base flood elevation (BFE) is established as 10-14 feet above mean sea level. Along the bayside, the BFE is established as 4-6 feet above mean sea level. In general, along either side of Coastal Highway, certain properties are no longer mapped in the Special Flood Hazard Area (100-year floodplain) resulting in approximately 4,838 structures located in Zone X (500-year floodplain or 0.2%) or lower flood risk area. As a growth area, which is already heavily developed, avoidance of the risk area is difficult. Ocean City's flood protection and storm water management regulations take into account the problems inherent in developing in the floodplain, and enforcement of these regulations should continue to be stringent.

Table 7-1: Flood Zone Descriptions

Flood Zone	Description
High Risk Areas	
AO	River or stream flood hazard areas, and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
AE	The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of A1-A30 Zones.

Flood Zone	Description
High Risk – Coastal Areas	
VE	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
Moderate to Low Risk Areas	
X	Area of minimal flood hazard, usually depicted on FIRMs as above the 500-year flood level. Zone X is the area determined to be outside the 500-year flood and protected by levee from 100-year flood.

Source: FEMA

The National Flood Insurance Program's (NFIP) Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. Ocean City participates in the NFIP making federally backed insurance available to all properties owners and renters. The Community Rating System (CRS), under FEMA, has been steadily improved over the years in Ocean City and continues to be a Class 7 community earning a 15% discount on all flood insurance premiums for Ocean City property owners. Hurricane Awareness Night, town website additions, and articles in the local papers continue to educate the public. This helps Ocean City to meet its objective to "Continue to participate in the Community Rating System, which provides reduced flood insurance premiums to reward stringent flood hazard protection regulations", from Chapter Seven, Sensitive Areas and Environmental Protection, in the 2006 Comprehensive Plan.

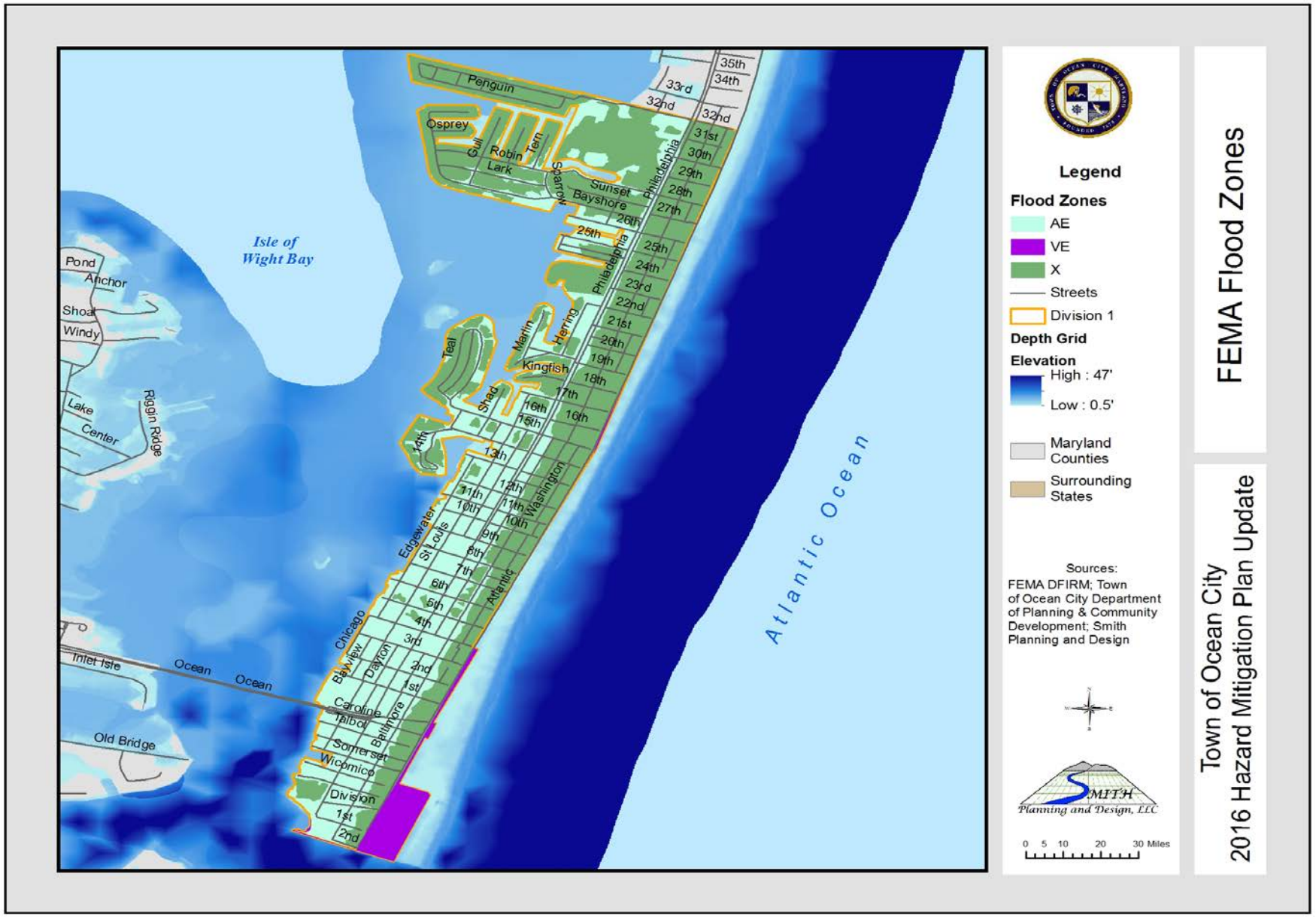
7.1.1 Flood Insurance Rate Maps

FEMA's new Flood Insurance Rate Maps (FIRM) became effective in July 2015, for the town of Ocean City. As a result of the revised flood maps, new flood zones and new flood rates apply to flood insurance policies. While many Ocean City properties experience insurance premium relief, it is important to remember that OC is a barrier island, subject to severe storms and flooding. Although lender banks may no longer require flood insurance, based on FEMA's FIRM map changes, approximately 30% of all flooding in the U.S. occurs in moderate to low risk flood zones. Further, studies show many properties without flood insurance typically are not rebuilt after a flood disaster.

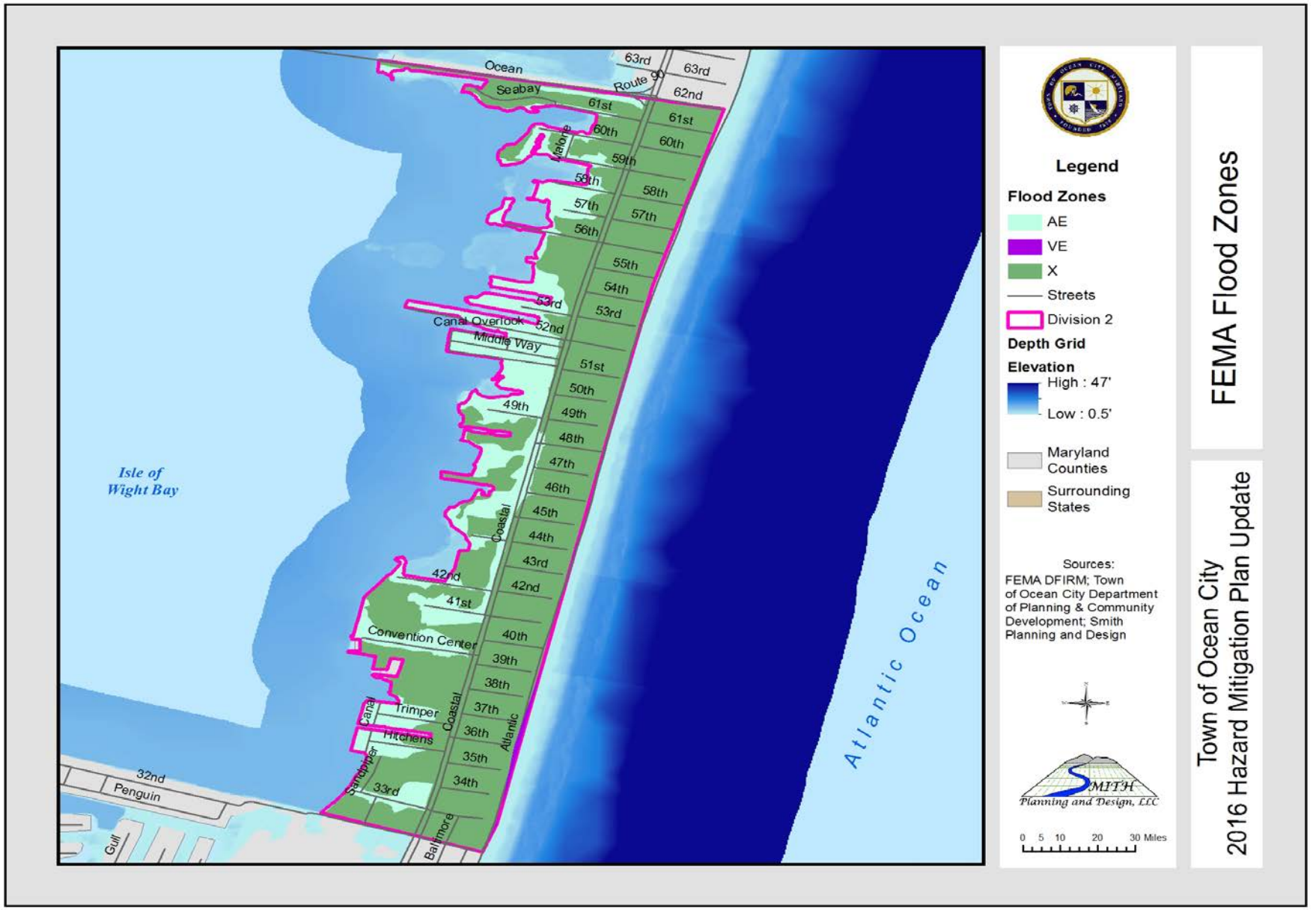
Flood zones are the geographic areas that FEMA has defined according to their varying levels of flood risk. The flood zones for Ocean City are described in Table 7-1 and displayed on Maps 7-1, 7-2, 7-3 and 7-4. Note, Division 5 contains the beach area only and Division 6 is comprised mostly of Zone X with Zone AE bordering the northern and eastern perimeter.

NOTE: All Divisions contain a VE Zone; however, this zone is located in limited areas along the ocean beach area.

Map 7-1: FEMA Flood Zones – Division 1

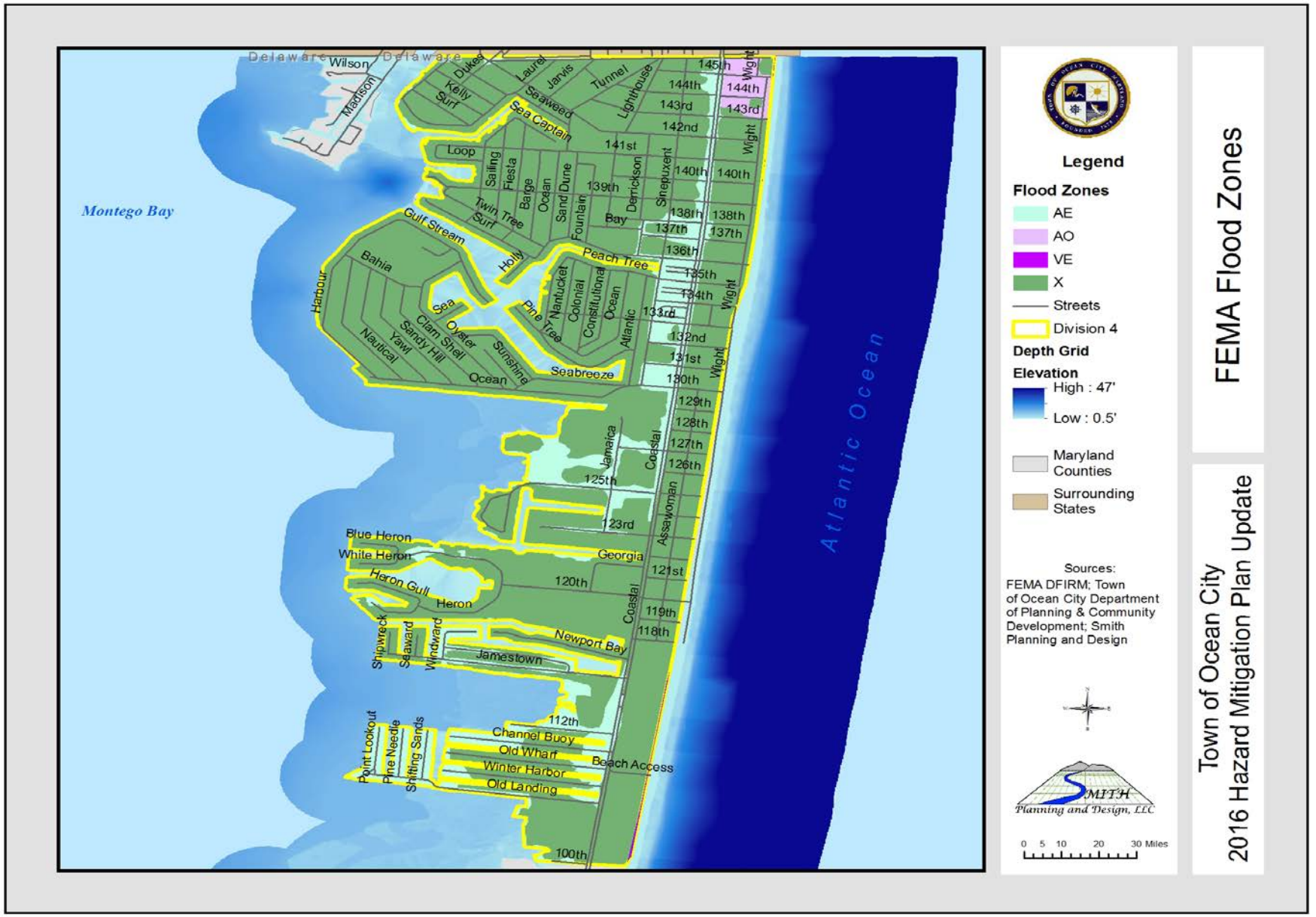


Map 7-2: FEMA Flood Zones – Division 2



Map 7-3: FEMA Flood Zones – Division 3

Map 7-4: FEMA Flood Zones – Division 4



In addition to viewing FEMA DFIRMs, the Flood Insurance Survey (FIS) should be reviewed. The Flood Insurance Survey (FIS) is a compilation and presentation of flood risk data for specific watercourses, lakes, and coastal flood hazard areas within a community. When a flood study is completed for the NFIP, the information and maps are assembled into an FIS. The FIS report contains detailed flood elevation data in flood profiles and data tables.

7.1.2 Coastal High Hazard Area

An area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources. The coastal high hazard area is identified as Zone VE on Flood Insurance Rate Maps (FIRMs). Map 7-1, FEMA Flood Zones, displays Division 1 containing the highest percentage of land within Zone VE out of the six divisions. Special floodplain management requirements apply in VE Zones including the requirement that all buildings be elevated on piles or columns.

In addition, FEMA FIRM mapping indicates that the bayside contains the highest percentage of Zone AE, which indicates a high risk area. This is especially true for Division 1, 2, 3, and 4.

7.1.3 Flood Insurance

Standard homeowners' insurance policies do not cover losses due to flooding. Ocean City participates in the National Flood Insurance Program, which makes federally backed flood insurance available to property owners. This insurance is required in many cases, such as when property is purchased with a federally backed mortgage and is located in the special flood hazard area. Property owners can insure buildings and contents against flood damage and renters can insure possessions. Condominiums should carry a flood insurance policy on the structure itself. Flood insurance is available to all property owners and renters. Ocean City residents are eligible for discounted flood insurance through the NFIP based upon the Town's participation in the Community Rating System.

7.1.4 Floodplain Development and Permit Requirements

Ocean City Code requires a building permit be obtained for nearly all construction and structural repair work, and for any development within the Special Flood Hazard Area mapped on the Flood Insurance Rate Maps. The city reviews plans to be sure buildings are constructed to withstand flooding. Permits are also required before any land development (grading, filling, etc.) in the floodplain to ensure activities do not increase flooding potential on or around property. Part of the permit process involves preparation of elevation certificates, which provide a record of the structure's lowest floor elevation to predicted flood levels. Department of Planning & Community Development maintain elevation certificates for review by insurance agents, property owners, and other interested persons and may be obtained information from Department of Planning & Community Development.

7.1.5 Ocean City Critical Area

Chapter 38-FLOODS, Article II, Section 38-31 of the Ocean City Zoning Ordinance designates two critical areas:

1. That area east of the easterly right-of-way line of Baltimore Avenue lying north of 26th Street and south of 23rd Street.
2. That area lying east of a point 250 feet west of the beach replenishment project line, lying north of 33rd Street and south of the division line between the State of Maryland and the State of Delaware.

NOTE: A minimum of three feet about the base flood elevation as shown on the flood insurance rate map or if located in a Zone X or other area without a mapped base flood elevation a minimum of three feet above the highest adjacent grade.

7.1.6 Natural & Beneficial Functions of Floodplains

Floodplains in their natural state provide many beneficial functions. Primary undeveloped floodplains areas in Ocean City are beaches and dunes, the first line of defense against flood damage from the ocean. Taking care of dunes by not walking on them and maintaining vegetation is essential to retaining their flood protection function. Bayside, wetlands and other open spaces act as sponges, storing floodwaters before they reach upland areas. Federal, State and Local regulations protect these natural areas.

7.2 Flood History (2000-2016)

Flooding can be categorized as flash**,** riverine and coastal in Maryland. **Flash flooding** results from a combination of rainfall intensity and duration, and is further influenced by local topography and the ground's capacity to hold water. **Riverine flooding** is caused by persistent moderate or heavy rain over one or more days, sometimes combined with snowmelt, causing a river to slowly rise and overflow its banks. **Coastal flooding** occurs when normally dry, low-lying land is flooded by seawater. The extent of coastal flooding is a function of the elevation inland floodwaters penetrate, which is controlled by the topography of the coastal land exposed to flooding.

Table 7-2: Flood Events (2000-2016)

Date	Event Narrative	Property Damage
September 3, 2000	Slow moving thunderstorm dumped heavy rainfall of over two inches in an hour in parts of Ocean City resulting in the closure of Coastal Highway in the northern part of the city.	0
September 1, 2002	Numerous roads and bridges reported closed due to flooding in Ocean City.	0
July 8, 2004	Flooding across 140th Street in Northern Ocean City.	0
July 8, 2005	Partial roof damage reported at both Ocean City Town Hall and Fire Station due to heavy rain.	$5,000
October 24, 2007	Heavy rainfall in a short duration averaging 2-3 inches.	0
October 29, 2012	Numerous road closures. Total rainfall ranged from five to nine inches of rain across Worcester County, while 7.22 inches of rain was reported for Ocean City.	0

Source: NWS, NCDC (NOAA)

7.3 Flood Vulnerability

The Non-Regional Coastal Flood Risk product was completed in 2015 for Worcester County. As part of the Ocean City plan update, data relating to Ocean City was extracted from the FEMA flood risk report and utilized. In addition, an Enhanced Hazus Analysis for coastal flood was conducted to assess the flood vulnerability of Ocean City's critical facilities as part of the plan update.

7.3.1 Non-Regulatory Coastal Flood Risk Product

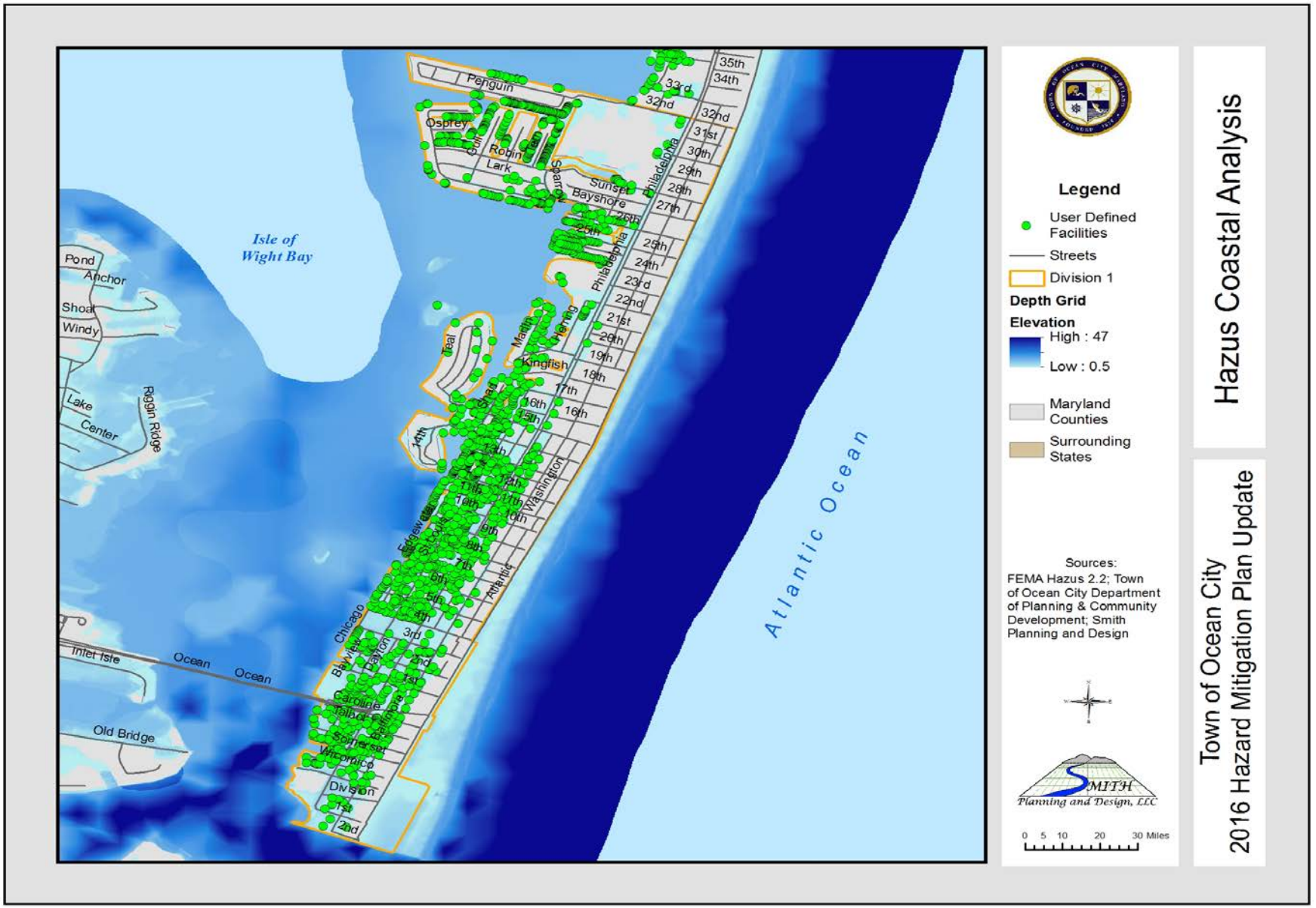
FEMA, in partnership with the Maryland Department of Environment (MDE) and Maryland Emergency Management Agency (MEMA), developed Non-Regulatory Coastal Flood Risk Product for jurisdictions located within the coastal area of the Chesapeake Bay. This planning initiative was intended to assist local communities with increasing their resiliency to flooding and to better protect their citizens. Results are provided in a Flood Risk Report (FRR), which are not intended to be regulatory or the final authoritative source of all flood risk data in the project area. The report is intended to be used in conjunction with other data sources to provide a comprehensive picture of flood risk within the project area.

FEMA's Hazus program was utilized to determine coastal flood losses for the 1-percent-annual-chance flood event. In order to accurately calculate loss estimates, user defined data was imported into Hazus for the coastal flood risk product. First, depth grids were developed using the high resolution digital elevation model (DEM) and FIRM Zones AE and VE with a static base flood elevation (BFE) for the approved Digital Flood Insurance Rate Maps (DFIRM). Flood depths were obtained by subtracting the water surface from the ground elevation; hence depth grids. Next, the user defined facility inventory was developed. User defined inventory includes: residential, commercial and other (industrial, agriculture, religion, government and educational). Building footprints were utilized to determine which structures were located within the flood zone. The lowest adjacent grade was determined for each structure within the flood risk area to depict where the flood will be the highest on each structure affected. Additionally, information

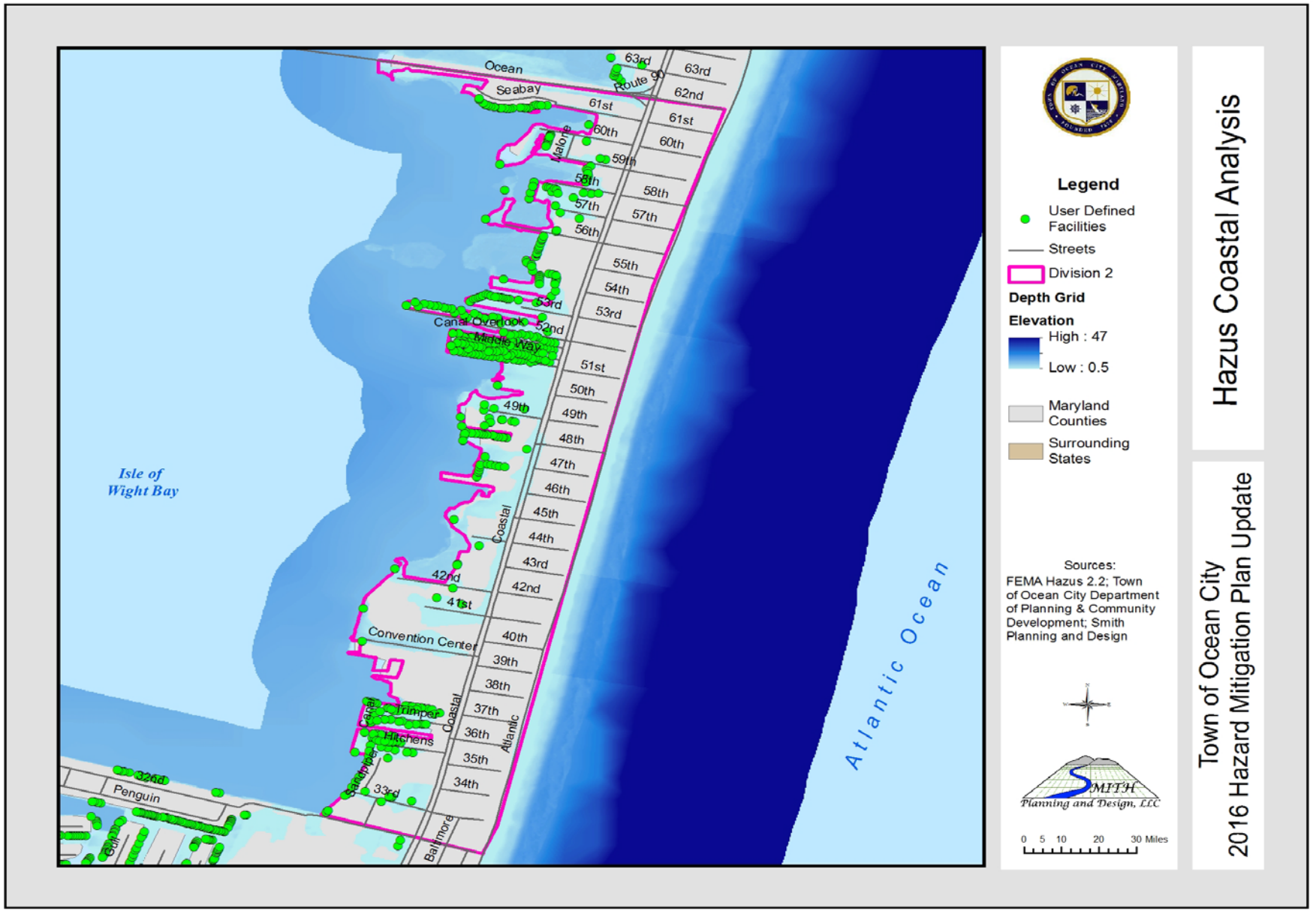
from the 2012 Maryland Property View Database was incorporated to ensure all necessary attributes were captured in order to obtain more accurate loss estimates. By inputting user defined data and inventory into the Hazus program, site-to-site results versus an aggregated table of damages and losses was provided. Maps below depict the depth grid and user defined structures located within the coastal 100-year floodplain.

A total of 3,480 structures are located within the coastal flood zone. These structures include condominiums containing several units, however each unit is singled out for analysis purposes. As depicted on Maps 7-5 to 7-8, affected structures (depicted as green dots) are concentrated along the bayside of Ocean City. Division 1 comprises 44% of structures located within the coastal floodplain, while Division 2 contains 12%, Division 3 has 11% and the remaining 33% are within Division 4. A total of 3,306 structures affected by coastal flooding are residential. The remaining structures are comprised of structures such as commercial and industrial.

Map 7-5: Hazus Coastal Analysis – Division 1

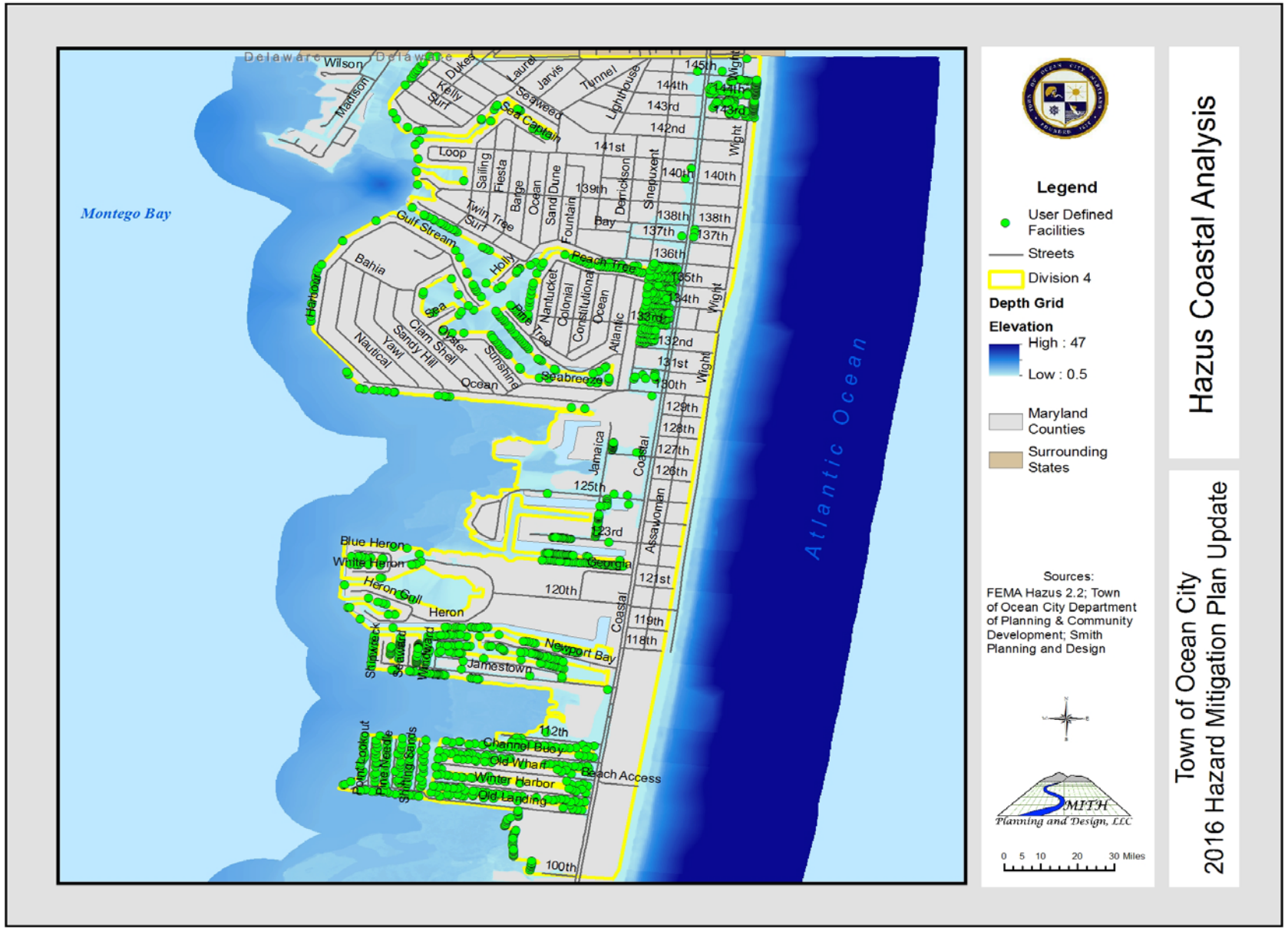


Map 7-6: Hazus Coastal Analysis – Division 2



Map 7-7: Hazus Coastal Analysis – Division 3

Map 7-8: Hazus Coastal Analysis – Division 4



7.3.2 Critical Facilities

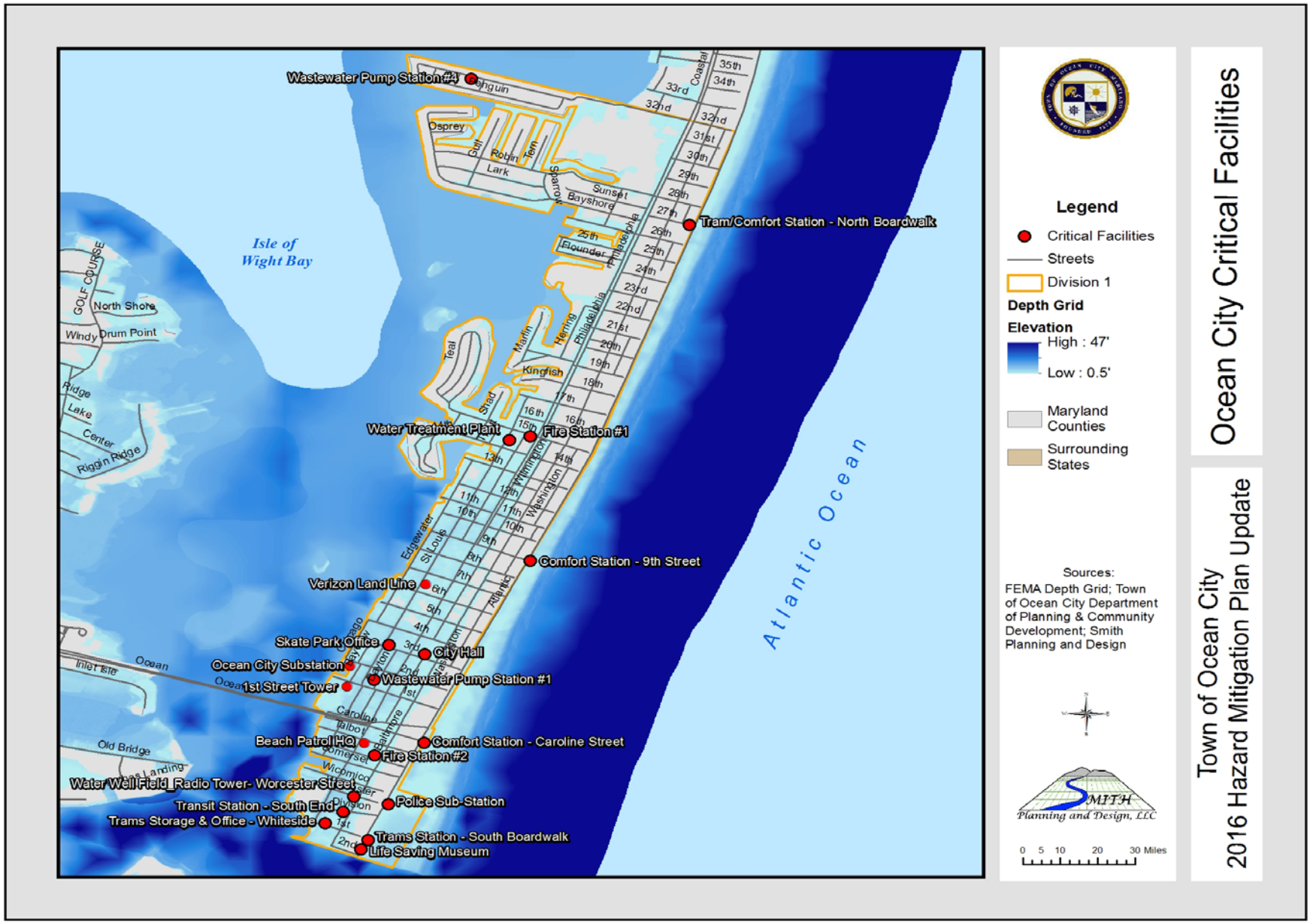
The Enhanced Hazus Coastal Flood analysis, conducted by Smith Planning and Design, utilized integrated user-supplied data in order to yield more accurate loss estimates and risk assessments for critical facilities located within Ocean City.

Input parameters for the Enhanced Coastal Flood analysis were updated utilizing the Ocean City geodatabase provided by the Town of Ocean City Department of Planning and Community Development, along with a critical facilities listing provided by Ocean City's Department of Emergency Services. Critical facilities were extrapolated from the geodatabase, which contained current point data for all structures. Attribute tables for the extracted critical facilities points were edited to included additional and updated data. The additional and updated data was captured from the 2012 Maryland Property View Database. The data extracted from the 2012 Maryland Property View Database included: building stories, year built, structure value and square footage. The complete methodology for the Enhanced Hazus analysis located in Appendix D. The types of critical facilities utilized in the Enhanced Coastal Flood analysis include: Emergency Operations Center, fire stations, police stations, schools, transportation, and government owned and utilities. Maps 7-9 to 7-13 depict critical facilities and flood depths per division. Note, Division 5 is comprised of the beach area and therefore contains no critical facilities.

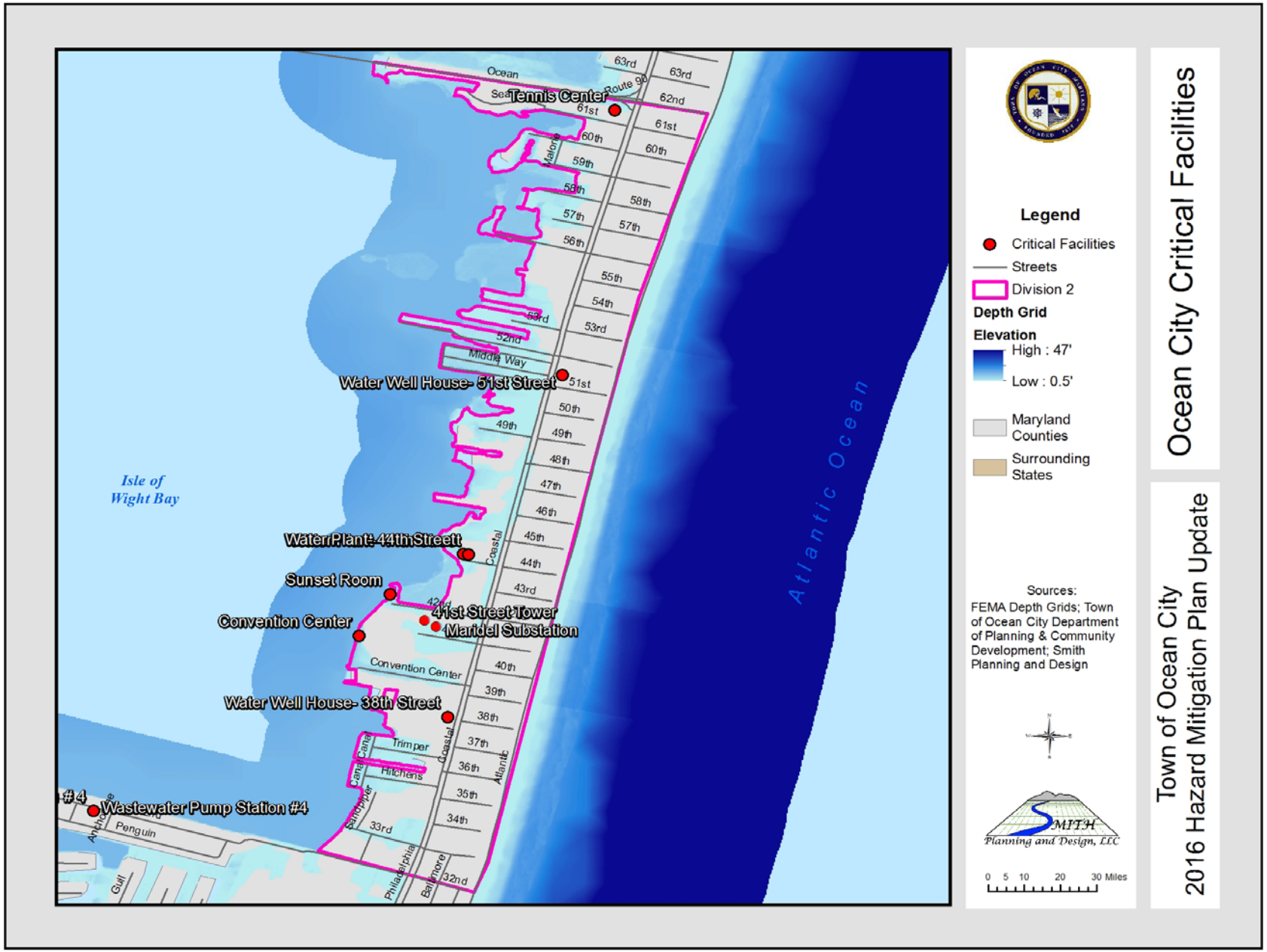
For some activities and facilities, even a slight chance of flooding is too great a threat. Typical critical facilities include hospitals, fire stations, police stations, storage of critical records, and similar facilities. These facilities should be given special consideration when formulating regulatory alternatives and floodplain management plans. A critical facility should not be located in a floodplain if at all possible. If a critical facility must be located in a floodplain it should be provided a higher level of protection so that it can continue to function and provide services after the flood. Communities should develop emergency plans to continue to provide these services during the flood.

Under Executive Order 11988, Floodplain Management, Federal agencies funding and/or permitting critical facilities are required to avoid the 0.2% (500-year) floodplain or protect the facilities to the 0.2% chance flood level.

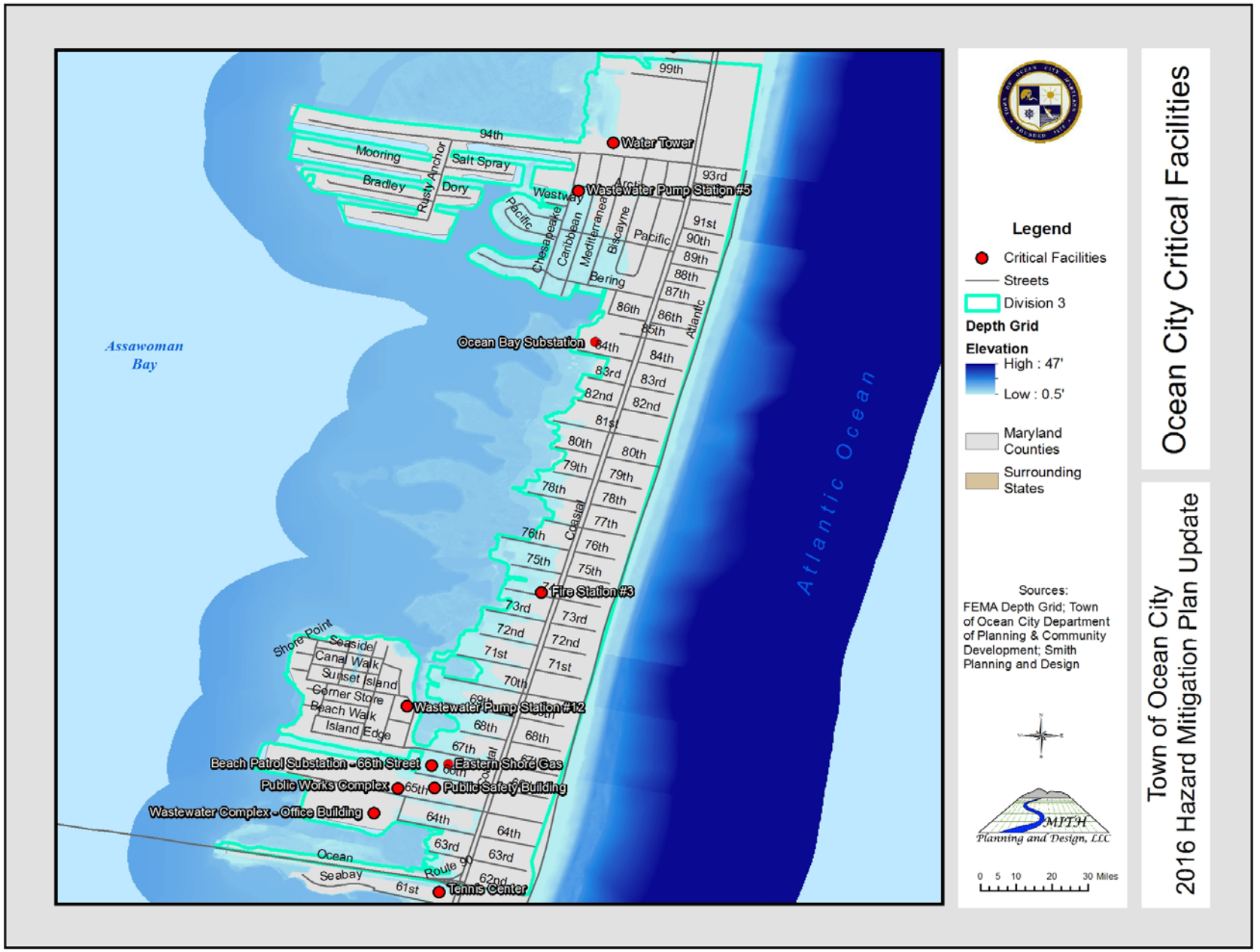
Map 7-9: Critical Facilities – Division 1



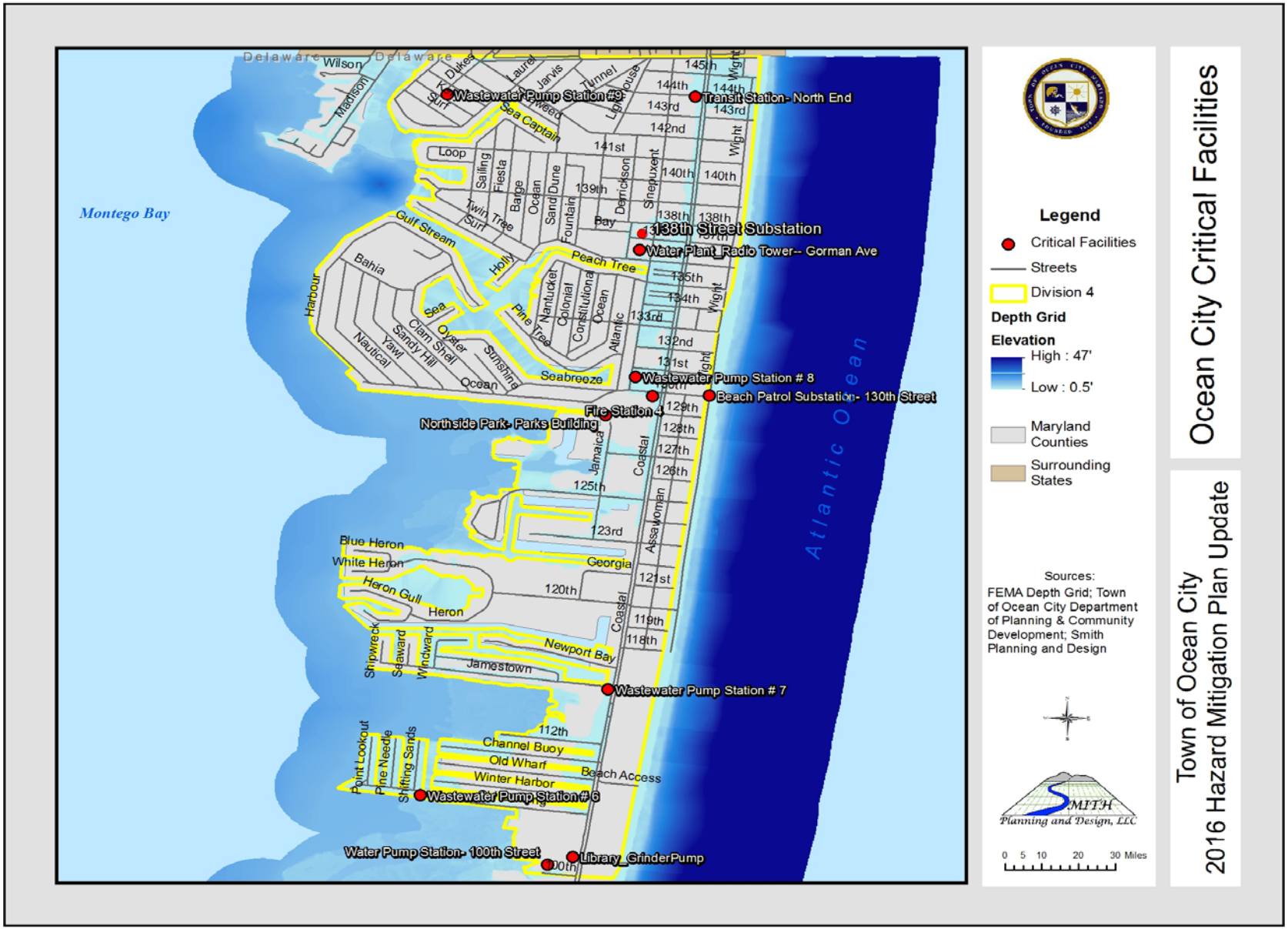
Map 7-10: Critical Facilities – Division 2



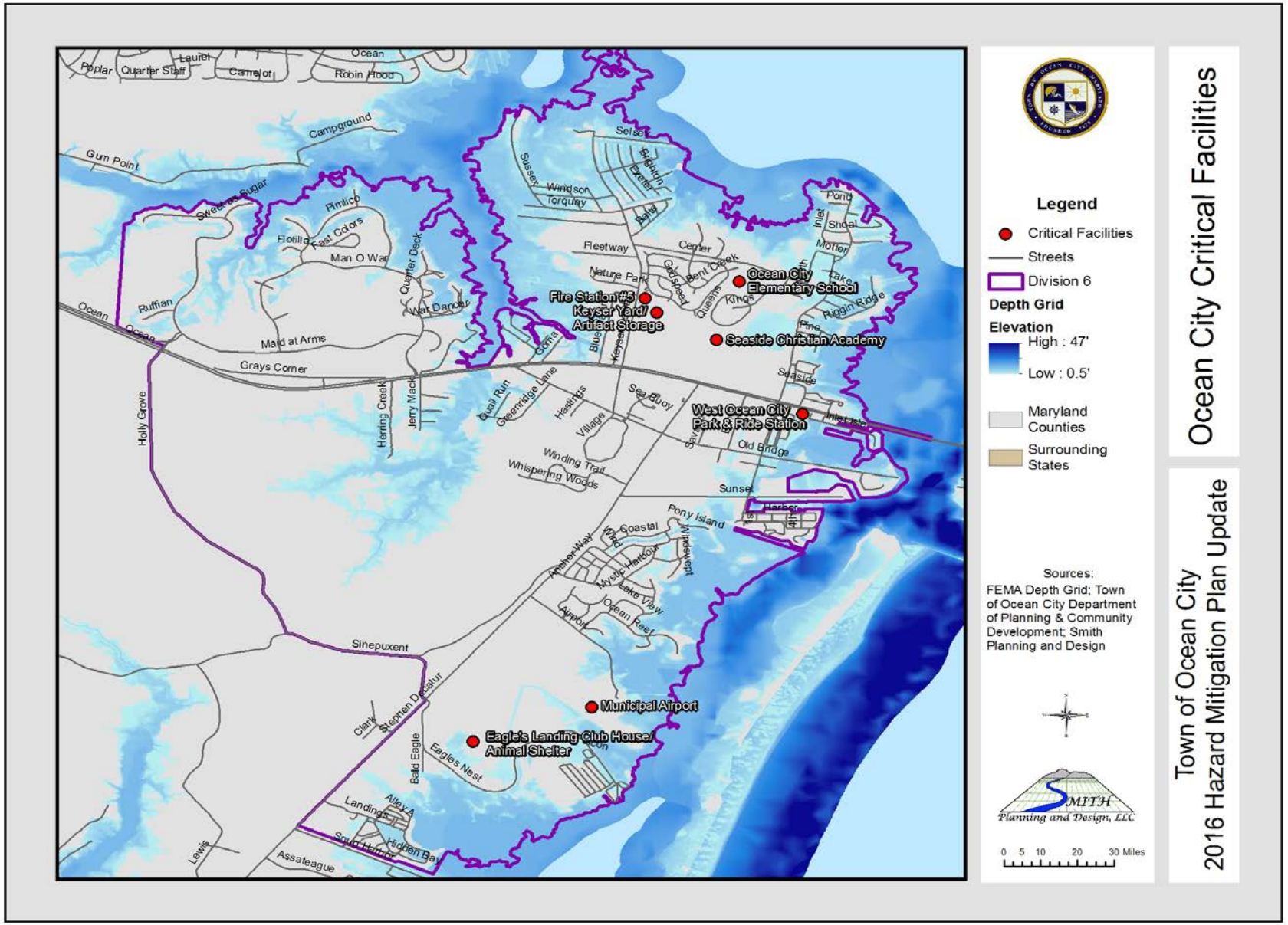
Map 7-11: Critical Facilities – Division 3



Map 7-12: Critical Facilities – Division 4



Map 7-13: Critical Facilities – Division 6



7.4 Flood Loss Estimation

The Enhanced Hazus Coastal Flood coastal flood hazards. Flood hazard is defined by a relationship between depth of flooding and the annual chance of inundation to that depth. Depth, duration and velocity of water in the floodplain are the primary factors contributing to flood losses. Other hazards associated with flooding that contribute to flood losses include channel erosion and migration, sediment deposition, bridge scour and the impact of flood-born debris. The Hazus Flood Model allows users to estimate flood losses due to depth of flooding. The flood model does not estimate the losses due to high velocity flash floods at this time.

7.4.1 Non-Regulatory Coastal Flood Risk Product

The Non-Regulatory Coastal Flood Risk analysis incorporates results from a Hazus Coastal Flood analysis which accounts for newly modeled areas in the Coastal Flood Risk Project and newly modeled depths for the 1-percent-annual-chance flood event. Potential losses were compared with state-level tax data and locally-provided building footprints to estimate loss estimations for the 1-percent-annual-chance flood scenario. The following tables provide the overall cost of structures within the flood prone areas and their associated loss estimates.

Table 7-3: User Defined Facilities within Affected Area

Political Area	Total Cost	Total Residential Cost	Total Commercial Cost	Total Other Cost
Town of Ocean City	$704,127,700.00	$527,047,800.00	$76,386,050.00	$100,711,850.00

Source: FEMA Flood Risk Report, 2015

Table 7-4: User Defined Facilities Loss Estimates within Affected Area

Political Area	Total Cost	Total Residential Cost	Total Commercial Cost	Total Other Cost
Town of Ocean City	$17,685,067.00	$17,402,063.00	$2,022,925.00	$848,086.00

Source: FEMA Flood Risk Report, 2015

7.4.2 Hazus Debris Generation

The Enhanced Hazus coastal flood model estimates that a total of 15,095 tons of debris will be generated. If debris tonnage is converted to an estimated number of truckloads, it will require 604 truckloads (@25 tons/truck) to remove the debris generated by the flood.

7.4.3 Hazus Shelter Requirements

The Enhanced Hazus Coastal Flood analysis estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. The Hazus model also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 887 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 1,680 people will seek temporary shelter in public shelters.

7.4.4 Critical Facilities

Several critical facilities within Divisions 2, 3, and 4 are located in the 100-year floodplain and are located in flood depths of 0.5 feet or less within these Divisions.

- Fire Stations #3 and #4;
- Wastewater Pump Station #5, #6, #7, #8;
- Sunset Room;
- Convention Center;
- Eastern Shore Gas;
- Beach Patrol Substation – 66th Street; and
- Maridel Substation.

The majority of critical facilities located within the 100-year floodplain are in Division 1. Table 7-5 provides the facilities within the affected area and the depth of flood for each structure. The depth of flood was measured at the structures' lowest adjacent grade. Most of these facilities were constructed to mitigate flooding, however; surrounding roads may cause evacuation issues.

Table 7-5: Division 1 Critical Facilities within Affected Area

Critical Facilities	Depth of Flood
Fire Station #1	0.5'
Fire Stations #2	0.8'
Wastewater Pump Station #1	1.3'
Comfort Stations – 9th Street	0.5'
Comfort Stations –Caroline Street	0.8'
Verizon Land Line	1.1'
Water Plant – 15th Street	0.5'
Skate Park Office	2.4'
City Hall	0.5'
Ocean City Substation	1.5'
1st Street Tower	2.2'
Beach Patrol Headquarters	1.7'
Water Well Field/Radio Tower – Worcester Street	2.4'
Transit Station – South End	2.5'
Tram Storage & Office – Whiteside	1.4'
Tram Station – South Boardwalk	0.5'
Life Saving Museum	0.6'

Source: Smith Planning & Design, HMPC & FEMA (Depth Grids)

According to the Hazus Coastal Flood Analysis, Fire Station #2 (constructed 1994) and Beach Patrol Headquarters (constructed 2015) could experience moderate damage; however, the Hazard Mitigation Planning Committee indicated flood damage has not occurred to these facilities in the past since this facility was constructed to the 500-year flood. As noted in Table 7-5, the flood depth at this facility is 0.8 feet.

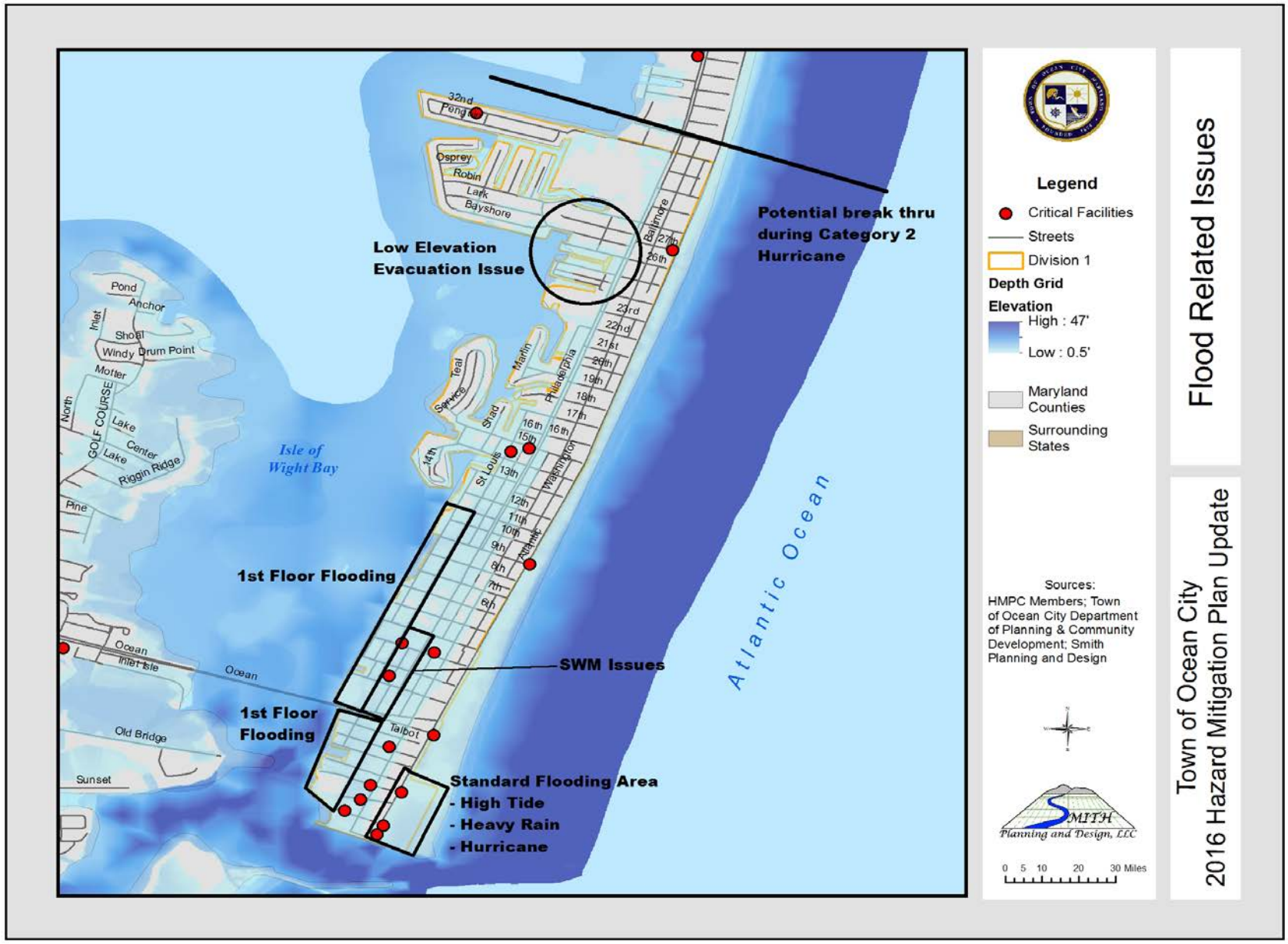
7.5 Flood Hazard Conclusion

Ocean City has been in the National Flood Insurance Program since June, 1971. The majority of structures, approximately 5,300 structures, within Ocean City were built after 1971, approximately 1,570 structures were built prior to 1971, and approximately 800 structures with no recorded date of construction. Structures built prior to the adoption of building codes should be assessed for potential mitigation opportunities. Divisions 1 and 4, as shown on Maps 7-5 and 7-8, have the highest concentration of structures located in coastal flood zones.

Flood related issues concentrated in Division 1 are depicted on Map 7-14. Division 1 continues to be the primary area impacted or initially impacted by flooding. As shown on Map 7-15, Ocean City Evacuation Zones, Division 1 is the first area to be evacuated, and therefore highly vulnerable.

The dunes and the sea wall have been protecting Ocean City's people and structures for many years. The continuation of the maintenance fund for periodic beach renourishment and dune stabilization should continue. The fund requires that each year $2 million dollars is deposited into the account by the Ocean City, Worcester County, and the State of Maryland.

Map 7-14: Flood Related Issues – Division 1



Map 7-15: Evacuation Zones – Division 1

Chapter 8– High Wind

HIGH WIND

Wind- Wind is the motion of air past a given point caused by a difference in pressure from one place to another. The effects can include blowing debris, interruptions in elevated power and communications utilities and intensified effects of winter weather. Two basic types of damaging wind events other than tropical systems affect Maryland: **synoptic-scale winds and thunderstorm winds**. Synoptic-scale winds are high winds that occur typically with cold frontal passages or Nor'easters. Downbursts cause the high winds in a thunderstorm.

8.1 High Wind Profile

The National Weather Service (NWS) defines high wind as sustained wind speeds of 40 mph or greater lasting for 1 hour or longer, or winds of 58 mph or greater for any duration.

During the 2011-2015 planning cycle, a severe storm event, a Derecho, occurred in the Mid-Atlantic region. A derecho is a complex of thunderstorms or a mesoscale convective system (MCS) that produces large swaths of severe, straight-line wind damage at Earth's surface. Johns and Hirt (1987) set spatial, temporal, and damage limitations when classifying thunderstorm complexes as derechos. Specifically, for an MCS to be classified as a derecho, the following conditions must be met:

- There must be a concentrated area of convectively induced wind damage or gusts greater than or equal to 58 mph occurring over a path length of at least 250 miles.
- Wind reports must show a pattern of chronological progression in either a singular swath (progressive; this event was a classic example) or a series of swaths (serial).
- There must be at least three reports separated by 64 kilometers (km) or more of Enhanced Fujita 1 (EF1 damage) and/or measured convective wind gusts of 74 mph or greater.
- No more than 3 hours can elapse between successive wind damage/gust events.

8.2 High Wind History (1996-2016)

Table 8-1: High Wind Events (1996-2016)

Date	Event Narrative	Property Damage
January 7, 1996	High winds combined with high tides caused significant beach erosion along the Ocean City Md beachfront during the afternoon and nighttime hours Sunday January 7th.	0
September 1, 2006	The remnants of Ernesto along the Mid Atlantic coast combined with strong high pressure over New England produced very strong winds across the Lower Maryland Eastern Shore. Sustained winds in mph ranged from the lower 40s to near 50 with maximum gusts ranging from the mid-50s to as high as the mid-70s. Some higher sustained winds included 49 mph (43 knots) at Ocean City, and 45 mph (39 knots) at Salisbury. Some higher maximum gusts included 75 mph (65 knots) at Bishops Head, and 70 mph (61 knots) at Smith Island. The high winds caused numerous downed trees and power outages, along with significant structural damage.	1M
May 11, 2008	Trees and powerlines were downed. Gusting wind blew part of the roof off Micky Fins restaurant in West Ocean City. Power outages stretched from Route 707 all the way to the Route 50 bridge into downtown. Ocean City Coast Guard Station measured a wind gust of 63 mph. High winds from strong low pressure downed trees and powerlines, and caused some structural damage. There were widespread power outages.	40K
October 29, 2012	Intense low pressure moving from off the northern Mid Atlantic Coast northwest into extreme southern New Jersey produced very strong west to northwest winds across the Lower Maryland Eastern Shore. The very strong winds downed numerous trees, produced minor structural damage, and caused scattered power outages. The very strong winds downed trees, produced minor structural damage, and caused scattered power outages. Wind gust of 64 knots (74 mph) was measured on the roof of Beach Plaza on 13th Street.	10K
January 23, 2016	Strong Low Pressure moving from the Southeast United States northeast and off the Mid Atlantic Coast produced very strong wind gusts across portions of the Lower Maryland Eastern Shore. Wind gust of 51 knots (59 mph) was measured at Ocean City Municipal Airport (OBX).	0
No crop damage or fatalities associated with these events.		

Source: NWS, NCDC (NOAA)

In terms of number of occurrences, the NWS, NCDC listed a total of five (5) wind events effecting Ocean City, Maryland from 1996-2016.

Table 8-2: Strong Wind Events (1996-2016)

Date	Event Narrative	Property Damage
May 6, 2007	Intense low pressure off the Mid Atlantic Coast produced very strong winds across portions of the Lower Maryland Eastern Shore. Wind gust of 48 mph was measured at OBX.	2K
No crop damage or fatalities associated with this event.		
November 3, 2007	The combination of Extra Tropical Storm Noel tracking up off the Mid Atlantic Coast and high pressure building into the region from the northwest produced strong northeast winds over portions of the Lower Maryland Eastern Shore. Wind gust of 51 mph was measured at 44009. Wind gust of 40 mph was measured at OBX.	1K
No crop damage or fatalities associated with this event.		

Source: NWS, NCDC (NOAA)

In terms of number of occurrences, the NWS, NCDC listed a total of zero strong wind events effecting Ocean City, Maryland during the 2011-2015 planning cycle. However, two events were recorded in 2007.

Power outage data by State from the Federal Emergency Management Agency (FEMA) provides impact information resulting from the July 2012 Derecho storm event on Table 8-3.

Table 8-3: July 2012 Derecho-Power Outage Data

State	Number of customers without Power on July 05, 2012	Number of customers without power at peak of outage
New Jersey	17,564	135,322
Washington, D.C.	1,000	68,567
Maryland	53,442	899,171
Virginia	89,104	1,076,051
Kentucky	1,000	52,616
Indiana	3,900	135,177
Ohio	139,080	915,366
West Virginia	226,483	643,284

Source: FEMA

8.3 High Wind Vulnerability & impacts

High and strong wind events also occur in Ocean City without the presence of thunderstorms. There are several reasons as to how winds can occur without the presence of thunderstorms, such as low pressure systems, cold fronts, remnants of hurricanes, and other meteorological causes. Table 8.1 and 8.2 list high wind and strong wind events chronologically in order to assess the history of high and strong wind events that have occurred in Ocean City. High wind events as characterized by the National Weather Service are winds that are over 50 knots (57.5mph) and strong wind events are less than 50 knots.

8.4 High Wind Conclusion

According to the Ocean City Building Code Regulations, the wind load design specification for new structures is 100 miles per hour. High wind events are typically associated with and are concurrent with other hazard events such as hurricane, tropical storm, Nor'easter, and severe thunderstorm. However, it is important to recognize high wind as an independent hazard in order to adequately develop hazard mitigation strategies and actions to mitigate impacts due to high wind. Older structures constructed prior to the 100 mph building code requirement are the most vulnerable to high wind impacts. New construction, especially commercial structures greater than two stories in height, should consider designing to a specification greater than the current minimum.

This page is intentionally blank.

Chapter 9 – Winter Storm

WINTER STORM

Winter Storm- Winter weather can take many forms including **snow, freezing rain, sleet and extreme cold** that may occur singly or in combination. Some of the most significant winter storms that affect Maryland are known as **"Nor'easters"** because they are accompanied by strong northeast winds.

9.1 Winter Storm Profile

Winter storms are defined by cold temperatures and heavy snow or ice and include heavy snowstorms, sleet storms, ice storms, blizzards, and severe blizzards. Winter storms may contain one or more types of hazardous weather events, the definitions of which are included below.

- **Heavy Snowstorm**: Accumulations of four inches or more in a six-hour period; or six inches or more in a 12-hour period. The most common impacts are traffic accidents, interruptions in power supply and communications; and the failure of inadequately designed and/or maintained roofing systems.
- **Sleet Storm**: Significant accumulations of solid pellets that form from the freezing of raindrops or partially melted snowflakes, resulting in slippery surfaces and posing hazards to pedestrians and motorists.
- **Ice Storm:** Significant accumulations of rain or drizzle freezing on objects such as trees, power lines and roadways, causing slippery surfaces and damage from the sheer weight of ice accumulation.
- **Blizzard:** Wind velocity of 35 miles per hour or more, temperatures below freezing, considerable blowing snow with visibility frequently below one-quarter mile, prevailing over an extended period of time.
- **Severe Blizzard:** Wind velocity of 45 miles an hour or more, temperatures of 10 degrees or lower, a high density of blowing snow with visibility frequently measured in inches, prevailing over an extended period of time.
- **Nor'easters:** The strong northeast winds that strike the coast and inland areas give the storm its name. For Nor'easters to occur in Maryland, an arctic air mass should be in place. While high pressure builds over New England, cold arctic air flows south from the high pressure area. The dense cold air is unable to move west over the Appalachian Mountains and so it funnels south down the valleys and along the Coastal Plain. Winds around the nor'easter's center can become intense. The wind builds large waves that batter the coastline and sometimes pile water inland causing major coastal flooding and severe beach erosion. Unlike hurricanes, which usually come and go within one tide cycle, the nor'easter can linger through several tides, each one piling more and more water on shore and into the bays and dragging more sand away from the beaches.

9.2 Winter Storm History (2011-January 2016)

Snow and winter storms are not uncommon in Ocean City. Since the City is subjected to cold weather conditions periodically, there have been several instances of winter storms that have occurred throughout Ocean City. In terms of number of occurrences, the NWS, NCDC listed a total of 5 Winter Storm events affecting Ocean City from 2011-2016. Detailed data for Winter Storm events that include impacts and damages are listed on the table below.

Table 9-1: Winter Storm Events (2011-2016)

Date	Event Narrative	Property Damage
January 28, 2014 to January 29, 2014	Coastal low pressure intensifying off the Mid Atlantic Coast produced snowfall ranging from four to five and a half inches of snowfall across the Maryland Eastern Shore. Snowfall report of 5.5 inches was reported at Snow Hill and reports of 4.0 inches of snow were reported from Newark and 1 mile south southwest of Ocean Pines.	0
No crop damage or fatalities associated with this event.		
March 16, 2014 to March 17, 2014	A complex area of low pressure developed along a stalled cold front across the Southeast United States with weak high pressure over New York, creating snow across the Lower Maryland Eastern Shore. Snowfall amounts between 4.5 inches and 6.2 inches occurred across the county, with 6.2 inches of snowfall reported 3 miles east of Bishopville and 6.0 inches reported 1 mile southwest of Berlin.	0
No crop damage or fatalities associated with this event.		
February 15, 2015 to February 16, 2015	Low pressure moving from the Southern Plains east northeast and off the Mid Atlantic Coast produced between four inches and eight inches of snow across the Lower Maryland Eastern Shore from Monday afternoon, February 16th through early Tuesday morning, February 17th. Snowfall amounts were generally between four inches and six inches across the county.	0
No crop damage or fatalities associated with this event.		
February 26, 2015	Intensifying low pressure tracking from the Gulf of Mexico northeast and off the southeast and mid-Atlantic coast produced between three inches and eight inches of snow across the Lower Maryland Eastern Shore from late Wednesday night, February 25th into early Thursday afternoon, February 26th. Snowfall amounts were generally between four inches and six inches across the county. Ocean City reported 5.0 inches of snow.	0
No crop damage or fatalities associated with this event.		
January 22, 2016 to January 23, 2016	Winter Storm Jonas was a Strong Low Pressure moving from the Southeast United States northeast and off the Mid Atlantic Coast produced between three and thirteen inches of snow and strong winds across the Lower Maryland Eastern Shore. Snowfall totals were generally between 2 inches and 5 inches across the county. Ocean Pines reported 3.0 inches of snow.	0
No crop damage or fatalities associated with this event.		

Jonas Storm Damage Repairs Estimated At $21M; 880,000 Cubic Yards Of Sand Lost
Feb 08,2016 by DispatchAdmin

OCEAN CITY — With heavy seas and a pending winter storm pounding the coast again on Monday morning, Ocean City officials have issued the initial estimates on the damage to the beach and dunes during Winter Storm Jonas late last month, including roughly $21 million needed in repairs.

In late January, Jonas, now deemed a 50-year storm, pounded the resort beaches for three straight days during what was essentially a classic Nor'easter during a full moon. The storm exacted a heavy toll on the beaches and dunes, the extent of which is just now being known. The federal Army Corps of Engineers late last week released the results of its recently completed initial estimates of the damages and a plan for emergency restoration.

According to the Army Corps' figures, the volume of sand lost during Jonas is estimated at 880,000 cubic yards. The estimated cost to repair the damage caused by the January storm came in at around $21 million. The Town of Ocean City is currently moving forward with emergency dune repairs through a partnership with the Maryland Department of Natural Resources.

The Army Corps of Engineers will be requesting funding for the full beach restoration. Just last week, the Mayor and Council signed off on a letter to Senator Ben Cardin (D-Md.) seeking continued funding for the beach replenishment project through the Water Resources Development Act.

The good news is, despite taking heavy losses, the dune system held up and did its job during Jonas. According to the Army Corps' estimates, the property damages prevented by the dunes during Jonas totaled around $190 million.

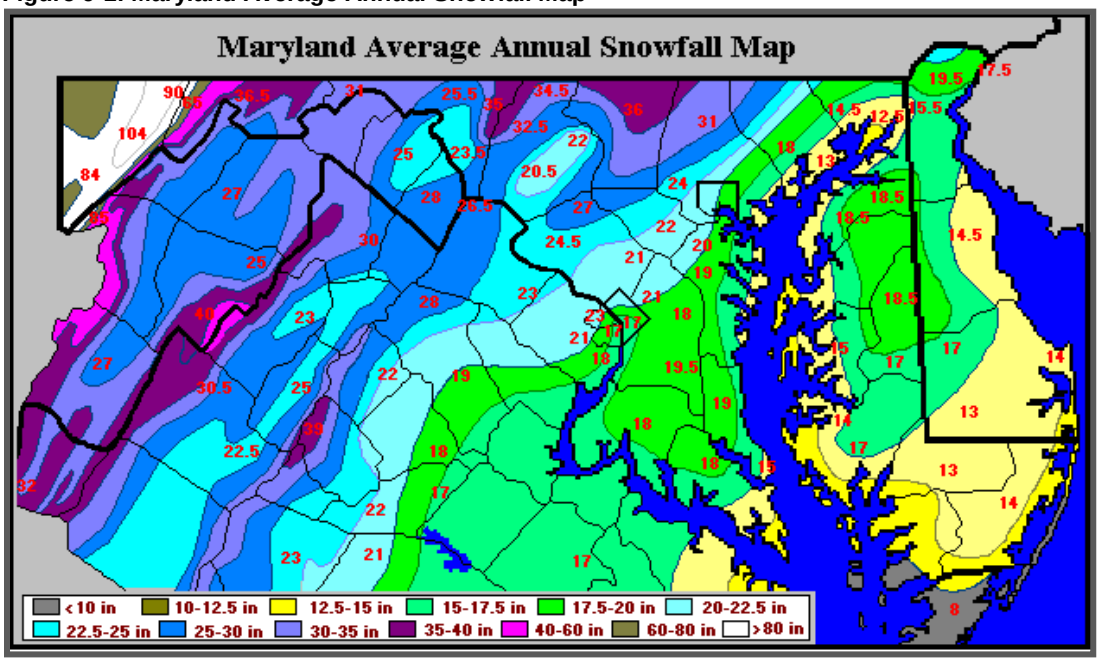
The Army Corps of Engineers replenishes the beaches in Ocean City every four years, along with occasional emergency repairs when necessary, such as the repairs now needed in the wake of Jonas. The last regularly scheduled beach replenishment project in Ocean City was conducted in 2014.

Beach replenishment is conducted through a federal, state and local partnership including the Army Corps, the state of Maryland, Worcester County and Ocean City, with the federal government paying the lion's share of the 50-year agreement. For example, the total current allocation is nearly $268 million, of which the federal government pays $146 million. Roughly $47 million had been allocated through 2013, leaving a balance of $98 million. The life of the project extends to 2044.

The beach and ocean at 67th Street is pictured Monday morning. Photo by Willie Frank

Source: ***https://mdcoastdispatch.com/2016/02/08/jonas-storm-damage-repairs-estimated-at-21m-880000-cubic-yards-of-sand-lost/***

Figure 9-1: Maryland Average Annual Snowfall Map



As illustrated in Figure 9-1, Ocean City's annual snowfall is approximately 14 inches. Significant snowfall amounts have the potential of damaging power lines, communication towers, interfering with transportation and damaging residential and commercial structures. In regards to critical facilities, the age and type of construction determines the vulnerability of the structure. Additionally, critical facilities should have an alternative power source in the chance power lines are downed due to winter storms. Critical facilities at a higher risk for structural damage or loss of power should be retrofitted to sustain the effects of winter.

9.3 Winter Storm Vulnerability & Sustainability

The impacts associated with a winter storm are depicted in the hazard characterization of this chapter. The main impact that a winter storm will have on critical and public facilities is closure of operations and power outages. Generators are necessary for critical facilities to continue to operate during power outages. Facilities such as emergency management, police, fire, and EMS stations must be able to operate during winter storm power outages in order to provide their services to the public.
Winter weathers underlying hazards can significantly affect the environment and everyday lives for many individuals. The impacts include:

- **Roads** - Roadways are impacted by freezing rain, sleet, and black ice can dramatically worsen the driving hazard by creating dangerously slick, icy road conditions. The melting/refreezing process can occur for many days after a storm, and will only end once all moisture is melted and evaporated, and road are dry.

- **Ice Accrual** – Freezing rain accumulation on trees can cause large limbs or whole trees to snap and possibly fall on homes, cars, and powerlines. This can create a very dangerous environment outdoors and widespread power outages.

- **Visibility**- Heavy snow can create dangerous driving conditions commonly referred to as “white out” conditions. The lack of visibility combined with slick, snow covered roads greatly increase the probability of an accident.

- **Loss of Power (Heating Hazards)** – As a result of power outages during very cold conditions, residents may be forced to find alternative means to heat their homes. Carbon monoxide poisoning is a concern due to improperly ventilated heating sources from space or kerosene heaters, furnaces, water heaters, gas stoves, fireplaces, and blocked chimneys.

- **Dangerously Cold Temperatures** – When temperatures fall in the teens and single digits, it becomes more dangerous to be outside for prolonged periods. Some major threats include wind chill, frostbite, and hypothermia.

- **Aircraft Icing** – Icing poses a major threat to air travel, resulting in lengthy flight delays and cancellations.

9.4 Winter Storm Conclusion

The current Ocean City Building Code for roof snow load is 20 pounds per square foot, the frost line depth is 18 inches, and the winter design temperature is 15 degrees Fahrenheit. Local building officials should review any available damage reports over the past planning cycle to ensure that the current codes properly mitigate potential winter storm hazard impacts. Emergency generator back-up power at Ocean City critical facilities should be maintained and reviewed annually.

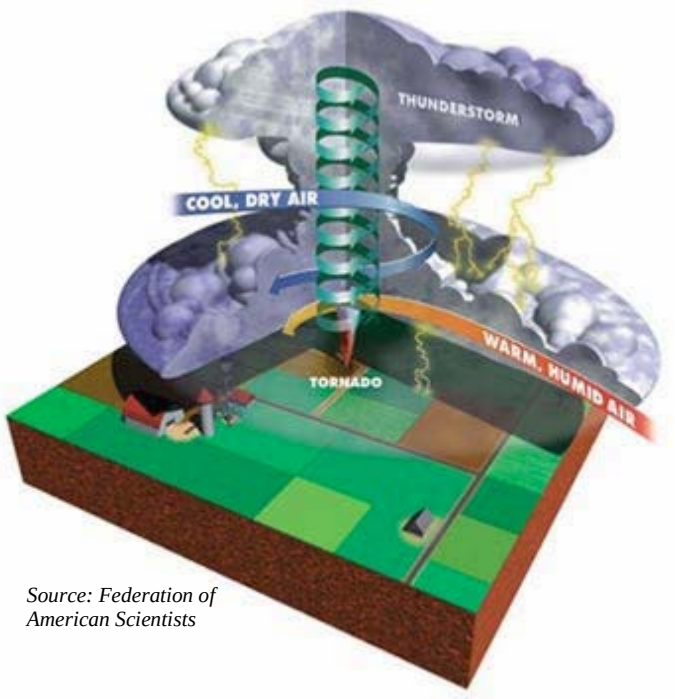
Chapter 10 – Tornado

TORNADO

Tornado- A tornado is a violently rotating funnel-shaped column of air that extends from a thunderstorm cloud toward the ground. Tornadoes can touch the ground with winds of over 300 mph. While relatively short-lived, tornadoes are intensely focused and are one of nature's most violent storms.

10.1 Tornado Profile

A tornado is defined by Strahler in his Physical Geography Text as a violently rotating column of air extending from a thunderstorm to the ground. Normally thunderstorms and associated tornadoes develop in warm, moist air in advance of strong eastward moving cold fronts in late winter and early spring. Tornadoes can also occur along a "dryline" which separates very warm, moist air to the east from hot, dry air to the west. Both of these scenarios are common in the Central Plains. Another way that tornadoes can be created occurs when warm moist air flows upslope. Under the right temperature and moisture conditions, intense thunderstorms can produce tornadoes in higher terrain.



Source: Federation of American Scientists

Tornadoes can be ranked by intensity by using the Fujita Scale devised by Dr. Theodore Fujita at the University of Chicago in 1971. The Fujita Damage Scale (F-Scale) is used to determine the tornado strength based on observed damage. The Fujita Tornado Scale assigns a category to tornados based on their wind speed and relates this to the general type of damage that is expected. The damage scale increases in intensity from a weak F0 (40 to 70 mph wind) to a F5 (over 260 mph wind). The Fujita scale of tornado intensity indicates that tornadoes at the F0 classification cause light damage to chimneys, tree branches, and signboards. Tornadoes of F1 magnitude can cause moderate damage to road surfaces, automobiles, and mobile homes. The impact of tornadoes primarily depends upon their occurrence in developed areas-tornadoes in undeveloped areas can cause damage only to a few trees and even go unreported.

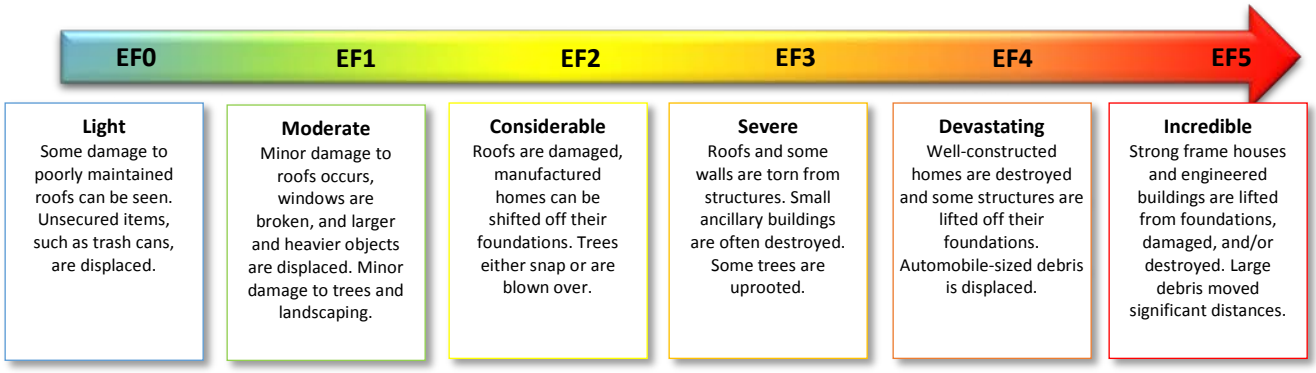
Table 10-1: Enhanced Fujita (EF) Scale

Table 10-1: Enhanced Fujita (EF) Scale						
Fujita Scale			**Wind Speed**		**Typical Damage**	
F Number	Fastest 1/4-mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)	**EF Number**	**3 Second Gust (mph)**
0	40-72	45-78	0	65-85	**0**	**65-85**
1	73-112	79-117	1	86-109	**1**	**86-110**
2	113-157	118-161	2	110-137	**2**	**111-135**
3	158-207	162-209	3	138-167	**3**	**136-165**
4	208-260	210-261	4	168-199	**4**	**166-200**
5	261-318	262-317	5	200-234	**5**	**Over 200**

Source: http://www.spc.noaa.gov/faq/tornado/ef-scale.html

According to NOAA, the Enhanced Fujita (EF) Scale has replaced the original Fujita (F) Scale used to rate tornadoes by the NWS. The EF Scale improves upon the limitations of the original F- Scale, which has been used since 1971. The tornado rating categories of the EF Scale range from zero to five, with EF0 as having the lowest wind speed and EF5 as having the highest wind speed. A correlation between the two scales has been developed and this makes it possible to express ratings in term of one scale to the other, thus preserving the historical database. The major improvements of the EF Scale are the more accurate wind speed ranges in each category and an increase in the amount of detail that goes into determining a tornado rating. These improvements will allow for more consistent and accurate tornado ratings by the NWS.

Figure 10-1 – Enhanced Fujita Wind Scale



10.2 Tornado History (1996-2016)

In terms of number of occurrences, the NWS, NCDC listed a total of three tornado events affecting Ocean City from 1996-2016, as shown in Table 10-2 below.

Table 10.2: Tornado Storm Events (1996-2016)

Date	Event Narrative	Property Damage
August 18, 1996	Small tornado reported by police at the Assateague Island State Park. A truck was overturned and several trees were uprooted. The storm moved over Sinepuxent Bay, crossed over the park then moved out into the ocean.	15K
No crop damage or fatalities associated with this event.		
September 15, 2011	Isolated severe thunderstorm in advance of a cold front produced a weak tornado across portions of the Lower Maryland Eastern Shore. Brief weak tornado (EF0) originally touched down just west of Ocean City in Assawoman Bay and weakened as it moved toward Ocean City. The tornado produced minor damage to several buildings with windows broken, siding ripped off, and minor roof damage. Damage generally occurred above the first floor. In addition, a number of vehicles had windows broken by flying debris. Winds with the tornado were estimated in the 60 to 70 mph range.	40K
No crop damage or fatalities associated with this event.		
August 8, 2016	A waterspout developed in Assawoman Bay, came ashore near the Route 50 and Philadelphia Avenue Intersection, and resulted in structural damage to several businesses in the surrounding area. A large supply container for the town of Ocean City was overturned and moved down the adjacent beach.	75K
No crop damage or fatalities associated with this event.		

10.3 Tornado Vulnerability & Sustainability

The entire state of Maryland is subject to the possibility of strong tornados. Even though the possibility of such a tornado occurring in Ocean City is low, it is a real danger and can occur at almost any time, anywhere in Ocean City. However, all new development within Ocean City is required to withstand 100 mph wind speeds.

10.4 Tornado Conclusion

The impact of tornadoes primarily depends upon their occurrence in developed areas; tornadoes in undeveloped areas may cause damage only to a few trees and may even go unreported. As development and population in Ocean City increases, a larger number of structures and people may be subject to tornadoes. Manufactured homes are especially at risk if proper stabilization measures are not ensured. Donaway Park is the largest manufactured homes park in Ocean City. As a result, the susceptibility to tornadoes increases and mitigation measures, such as tie-downs must be enforced.

This page is intentionally blank.

Chapter 11– Thunderstorm

THUNDERSTORM

11.1 Thunderstorm Profile

Thunderstorms are usually high intensity storms of short duration originating in a warm moist air mass that either is forced to rise by mountainous terrain or by colliding with a cooler dense air mass. The process of convection in the atmosphere brings about the release of moisture from the warm air mass as it rises, cools and condenses. This condensation proceeds until most of the moisture in the air mass has been precipitated. Since the motion of the air is nearly vertical, and attains high velocities, rainfall is intense and generally concentrated over a small area in a short time frame. Thunderstorms can be 10-15 miles in diameter and normally last 20-30 minutes.

11.2 Thunderstorm History

The National Weather Service considers a thunder storm severe only if produces wind gusts of 58 mph or higher, large hail (3/4 in. diameter or larger), or tornados.
Between 1995 and 2016, the *National Weather Service, National Climatic Data Center* reported 11 thunderstorm wind events that have occurred in Ocean City. Thunderstorm wind events with reported property damage are shown in Table 11.1.

11.3 Thunderstorm Wind History (1995-2016)

Table 11-1: Thunderstorm Wind Events (1995-2016)

Date	Event Narrative	Property Damage
November 11, 1995	Microburst caused extensive damage to a several block area (65th to 74th streets) in Ocean City. Roof damage, some significant, to several motels, homes and restaurants. One older home completely unroofed. Numerous boats in dry dock were overturned and damaged or destroyed by the microburst. Flying debris caused other minor structural damage. Approximately 15 power poles were snapped off, and numerous signs were damaged or destroyed. Power out to 7,300 customers. Winds estimated between 75 and 100 mph.	1M
No crop damage or fatalities associated with this event.		
May 4, 1996	Estimated 60-70 mph winds blew down power lines and toppled 2 circus-type tents.	N/A
No crop damage or fatalities associated with this event.		
July 3, 1996	Coast Guard Station measured a wind gust of 58 mph.	N/A
No crop damage or fatalities associated with this event.		
June 13, 1998	Several trees down near golf course along Route 50.	2K
No crop damage or fatalities associated with this event.		
February 12, 1999	Wind gust to 60 mph reported at Public Safety Building.	N/A
No crop damage or fatalities associated with this event.		
May 13, 2002	Minor damage to several structures. Roof partially torn off one building.	15K
No crop damage or fatalities associated with this event.		

Date	Event Narrative	Property Damage
May 18, 2002	Tree limbs down and minor roof damage on 136th street.	3K
No crop damage or fatalities associated with this event.		
August 26, 2003	N/A	N/A
No crop damage or fatalities associated with this event.		
August 27, 2003	Wind gust of 58 mph measured.	N/A
No crop damage or fatalities associated with this event.		
June 23, 2008	Fire siren was blown down in West Ocean City.	2K
No crop damage or fatalities associated with this event.		
June 29, 2012	A derecho produced a widespread path of damaging winds across much of the Lower Maryland Eastern Shore. Large tree was downed on a home in Ocean Pines. Several additional trees were downed.	2K
No crop damage or fatalities associated with this event.		

Source: NWS, NCDC (NOAA)

In terms of number of occurrences, the NWS, NCDC listed a total of 6 thunderstorm wind events with reported property damage affecting Ocean City from 1995-2016.

11.4 Thunderstorm Wind Vulnerability & Sustainability

Thunderstorms can cause damage to buildings, downed trees, which can block roads, and power outages from downed poles and lines in Ocean City. The events per year rate for this hazard at times may be high when compared to other hazards, however most events cause little or no damage to buildings such as critical and public facilities.

11.5 Hail Profile

According to *NOAA*, hail is a form of precipitation that occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they form into ice. Hail is only formed during a thunderstorm event. Property damage, specifically crop damage can be caused as a result of hail. Nationally hail causes approximately $1 billion in damage to property and crops each year. In fact, on April 10, 2001 hail caused $2 billion in damages to Kansas City. Due to the complexities and various factors involved in the formation of hail particle size and weight can vary tremendously. The typical size of hail is less than 2 inches in diameter; however, hail size may be up to seven inches in diameter as recorded in Nebraska.

11.6 Hail History (1993-2016)

No property or crop damage was reported from hail events by the *National Weather Service-National Climatic Data Center* for Ocean City. This could be attributed to the fact that if any damage did occur it was not significant enough to be reported.

Table 11-2: Hail Events (1993-2016)

Date	Event Narrative	Property Damage
April 1, 1993	N/A	0
No crop damage or fatalities associated with this event.		

Date	Event Narrative	Property Damage
November 11, 1995	One-inch hail damaged a car windshield.	0
No crop damage or fatalities associated with this event.		
May 9, 1997	N/A	N/A
No crop damage or fatalities associated with this event.		
June 23, 2008	Penny size hail was reported in West Ocean City.	0
No crop damage or fatalities associated with this event.		
May 29, 2009	Nickel size hail was reported.	0
No crop damage or fatalities associated with this event.		
July 27, 2009	Resident of north Ocean City reported quarter size hail that fell for around 5 minutes and covered the ground. The hail damaged 4 to 5 cars and also caused damage to the aluminum siding of a mobile home.	2K
No crop damage or fatalities associated with this event.		

Source: NWS, NCDC (NOAA)

In terms of number of occurrences, the NWS, NCDC listed six hail events affecting Ocean City from 1993-2016.

11.7 Hail Vulnerability & Sustainability

Crop damage is one of the most significant concerns during a hail event. Ocean City does not contain agricultural lands; therefore, little-to-no crop damage due to hail events has been reported. In addition to crop damage, property damage may occur during hail events. Auto dealerships are particularly vulnerable due to the large volume of product located outdoors. The scale of damage due to the quantity of vehicles on large open parking lots can oftentimes be significant, as it is a cumulative impact.

11.8 Conclusion

Intense thunderstorm events and the associated hazards (high wind, hail, lightening, etc.) that potentially accompany thunderstorms can result in impacts and damages similar to other hazards described herein. However, thunderstorm events are typically shorter in duration and therefore the temporal nature of the event reduces the probability of large-scale impacts. This does not imply that impacts due to thunderstorms do not need to be assessed and mitigated for, if possible. For example, damaging winds from thunderstorm events have caused problems with communication towers within Ocean City, specifically the tower located adjacent to the Ocean City Public Safety Building. Impacts to communication towers are problematic especially during a hazard event; however, actions were implemented to address and mitigate the issue from reoccurring.

Section 3 – Mitigation Strategies & Implementation

TASK 6	Develop a Mitigation Strategy	Chapter 12-Mitigation Strategy
TASK 7	Keep the Plan Current	Chapter 13-Plan Maintenance & Implementation
TASK 8	Review and Adopt the Plan	

Section 3 details the process used by the Hazard Mitigation Planning Committee to develop mitigation goals, actions, and priorities. A series of workshops were held with various stakeholders to examine current capabilities and develop new mitigation strategies. Three (3) workshops were held on March 8, 2016 at the Ocean City Beach Patrol Headquarters. Meeting minutes detailing these workshops and attendees are located in Appendix H: HMPC Meeting Minutes. A total of fifteen (15) new mitigation actions and projects were identified. These actions will be reviewed and updated annually as part of the plan maintenance and implementation process.

Chapter 12–Mitigation Strategy

12.1 Mitigation Strategy

A mitigation Strategy serves as the long-term blueprint for reducing the potential losses identified in the risk assessment. The mitigation strategy describes how the community will accomplish the overall purpose, or mission, of the planning process. Task 6 shows the development of the mitigation process.

Mitigation Goals are general guidelines that explain what the community wants to achieve with the plan.

Mitigation Actions are specific projects and activities that help achieve the goals.

The Action Plan describes how the mitigation actions will be implemented, including how those actions will be prioritized, administered, and incorporated into the community's existing planning mechanism.

12.2 Mitigation Goals

Upon completion of the 2016 Hazard Identification Risk Assessment and Vulnerability Analysis, the Hazard Mitigation Planning Committee (HMPC) was able to develop goals as part of the mitigation strategies. The goals serve as the basis for implementing mitigation action items, which aid in mitigating the hazards that have impacted or potentially will impact Ocean City, Maryland.

1. Implement preventive measures to mitigate hazards and increase community resiliency.
2. Continue to improve CRS rating in order to decrease the cost of flood insurance for Ocean City residents by:
   - Reduce flood losses;
   - Facilitating accurate insurance ratings; and
   - Promote the awareness of flood insurance.
3. Encourage and promote property protection measure by modifying buildings to withstand floods, erosion, and wave action or by removing buildings from hazardous locations.

4. Preserve and/or restore natural areas such as floodplains, wetlands and dunes and their natural functions.
5. Undertake structural mitigation projects to lessen the impacts of flooding to protect already existing development and critical facilities.
6. Conduct public education and awareness activities.
7. Implement emergency services measures to minimize hazard impacts on people and property.

12.3 Mitigation Actions

Mitigation actions address the goals and objectives developed by the Hazard Mitigation Planning Committee. These actions form the core of the Ocean City Hazard Mitigation Plan. These mitigation actions were grouped into the following six broad categories:

1. **Prevention.** Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and storm water management regulations.

2. **Property Protection.** Actions that involve the modification of existing critical and public facilities, buildings, structures, and public infrastructure to protect them from hazards. Examples include acquisition, elevation, relocation, structural retrofits, storm shutters, and infrastructure modification.

3. **Public Education and Awareness.** Actions to inform and educate citizens, elected officials, and property owners about potential ways to mitigate for hazards that can occur in the County. Such actions include outreach programs, projects, real estate disclosure, hazard information centers, and school-age and adult education programs.

4. **Natural Resource Protection.** Actions that, in addition to minimizing hazard losses also preserve or restore the functions of natural protection systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration preservation.

5. **Emergency Services.** Actions that protect people and property during and immediately after a disaster or hazard event. Services include warning systems and emergency response services.

6. **Structural Projects.** Actions that involve the construction of structures to reduce the impact of a hazard event. Such structures include dams, levees, floodwalls, seawalls, retaining walls, barrier islands, and safe rooms.

There are currently ten (10) existing Mitigation Action Items that were identified in the *2011 Ocean City, Maryland All-Hazard Mitigation Plan.* These projects were developed from the mitigation action items that were identified by the 2011 HMPC. The table below lists the ten (10) 2011 projects and the associated 2016 status.

Table 12-1: Mitigation Project Status

2011 Mitigation Project	2016 Status
CERT Training *CERT Training classes are conducted annually.*	Ongoing
Comprehensive Emergency Operations Plan *Elements of the Plan Update have been developed. Specifically, designation of Response Division Areas and mapping. Response Area Divisions were used as Mitigation Planning Areas during the 2016 Plan Update. Also, Incident management information including response, recovery, mitigation, and preparedness were updated.*	Current & Revised as Required
Develop Post-Disaster Plan – Comprehensive Recovery Plan	Underway
Property Protection Activities *Project 1: Bearing Road – elevation project that is complete* *Project 2: Tide Gate Project – in process* *Project 3: Beach Patrol Elevation Project – completed 2015*	Project 1: Complete Project 2: In Process Project 3: Complete
Datum Markers/Benchmarks *Ocean City installed over forty permanent benchmarks. These benchmarks are available on the website and may be viewed using adobe viewer.*	Complete
Database to Forecast Structure Vulnerability	Incomplete
Policy to Increase Elevation of Streets in areas where feasible during local improvements	Ongoing
Preparation and Implementation of the Maryland's Coastal Bays Program-Comprehensive Conservation and Management Plan. *Ocean City is an active member in the Maryland Coastal Bay Program.*	Ongoing
Public Information Activities Advisement *Community Newsletter advertising CERT training and Hurricane Preparedness Workshops annually. These programs are also advertised on County website.*	Complete
Beach Sand Replenishment *Dune sustainability and management is an ongoing project.*	Ongoing

Source: Ocean City Hazard Mitigation Planning Committee

12.4 2016 Mitigation Action Items and Rankings

The following table lists the mitigation action items that were developed by the 2016 HMPC. A fillable Adobe PDF containing mitigation actions and associated information was provided to all HMPC members for ranking purposes. The table listed location/responsible entity, goals for each action item, provides the time frame for completion, associate hazard. All HMPC ranking forms were collected and a composite ranking was added to the 2016 Mitigation Action Items table. Committee members rated each action item as low, medium or high priority. The mitigation table below shows the composite of the committee's rankings.

Overall there are five (5) action items rated as high and are shown in bold type on the 2016 Mitigation Action Items. An additional five (5) action items were rated medium and one (1) action items were rated as low. Of high rated actions, one (1) is prevention related, two (2) are related to property protection, one (1) public education and awareness, and one (1) is related to structural projects. These actions were ranked by the HMPC by their importance, (high, medium, or low) which focused heavily on what mitigation projects were the most beneficial.

2016 MITIGATION ACTIONS ITEMS & RATINGS

During the 2017 Plan Update, the following mitigation actions were developed. Action item were ranked "High", "Medium" or "Low". *Note - Timeframe Definitions: Short-term is less than 0-2 years and long-term is 2-5 years.*

Table 12-2: 2016 Mitigation Action Items & Ratings

ACTION	LOCATION/ RESPONSIBLE ENTITY	GOALS	TIMEFRAME	HAZARD	RATING
PREVENTION: Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses.					
Roadway Flooding – Roadway Flooding During Heavy Rain Events (Southbound) Coastal Highway @ Roadway 100 to 91st & 130-136th (Road Elevations and Drainage Issues) Standing Water, History of Flooding. Storm Drains located on straight need to be increased in size or multiple storm drains installed.	Town of Ocean City/State Highway Administration		TBD	Flooding	**HIGH**
PROPERTY PROTECTION: Actions that involve the modification of existing critical and public facilities, buildings, structures, and public infrastructure to protect them from hazards.					
65th/Bayside Flooding, Heavy Rain (Public Works Complex) – Elevate Street, Improve Drainage.	Town of Ocean City/State Highway Administration		TBD	Flooding	**HIGH**
Property Protection – Transformer Damage, No Power. Higher Elevation or Relocate Transformers	Public Works		TBD	Coastal Hazards	**HIGH**
Protection from Lightning Strikes – Lightning Arrestor System – Install Grounding Devises on Towers. Install Surge Protection Devises on Outreach to Condo. Information for Public Safety on Beach Patrol	Town of Ocean City Emergency Management/Risk Management		On-Going	Coastal Hazards	MEDIUM

ACTION	LOCATION/ RESPONSIBLE ENTITY	GOALS	TIMEFRAME	HAZARD	RATING
PUBLIC EDUCATION AND AWARENESS: Actions to inform and educate citizens, elected officials, and property owners about potential ways to mitigate for hazards that can occur in the County.					
Virus Outbreak – Protective Measures: Clothing, Education, Monitoring	Emergency Management		On-Going	Epidemic	LOW
Severe Weather Alert and Awareness – Rapidly Developing Weather Event Notification	Beach Patrol/Police Department/ Communications		6 Months	High Wind/ Thunderstorm	**HIGH**
NATURAL RESOURCE PROTECTION: Actions that, in addition to minimizing hazard losses also preserve or restore the functions of natural protection systems.					
Dune Grass Management Plan (& Native Plants) – Continual inspection and replacement of dune grass and vegetation, fertilization, and application of minerals, etc., as needed.	Public Works Beach and Parks Department		1 Year	Flooding	MEDIUM
EMERGENCY SERVICES: Actions that protect people and property during and immediately after a disaster or hazard event. Services include warning systems and emergency response services.					
Warning System Upgrade	Ocean City Fire Department		TBD	Tornado	MEDIUM
Extreme Temperatures: Heat Warnings – 3 Days or more	Emergency Management		On-Going	Extreme Heat	MEDIUM
STRUCTURAL PROJECTS: Actions that involve the construction of structures to reduce the impact of a hazard event.					
Secure Area of 33rd Street – Investigate Methods to Prevent Breach	Public Works		TBD	Coastal Hazards	MEDIUM
Storm Surge – Implementation of Inlet Dredging and Beach Nourishment/Dune Construction to Minimize Strom Damage	NPS Town of Ocean City – Engineering Worcester County		Scheduled for 2017-2018	Coastal Hazards	**HIGH**

12.5 Priority Projects – High Priority

Table 12-3: Mitigation Strategy Project 1

Jurisdiction/ Responsible Entity:	Town of Ocean City/State Highway Administration
Mitigation Action/Project Title:	Repetitive Roadway Flooding
Background/Issue:	Roadway Flooding During Heavy Rain Events and/or other extreme weather events(Southbound) Coastal Highway @ Roadway 100 to 91st & 130-136th (Road Elevations and Drainage Issues) Standing Water, History of Flooding Storm Drains Located on Straight
Ideas for Integration:	Re-engineering, Improve Elevation, More Drainages on Coastal Highway Add to Transportation Element within Comprehensive Plan
Responsible Agency:	Town of Ocean City/State Highway Administration Department of Public Works
Partners:	Town of Ocean City/State Highway Administration
Potential Funding:	Grant MDOT - SHA
Cost Estimate:	Millions
Benefits: (Losses Avoided)	Safety, Traffic Improvement
Timeline:	TBD
Priority:	HIGH
Worksheet Completed by:	Solid Waste, Worcester County, Parks & Rec, Finance, Construction, and Maintenance Depts.

Table 12-4: Mitigation Strategy Project 2

Jurisdiction/ Responsible Entity:	Town of Ocean City/State Highway Administration
Mitigation Action/Project Title:	Bayside Flooding at 65th Street – Public Works Complex Portions of 65th Street are with the FEMA Special Flood Hazard Area, Zone AE, and is therefore Considered at High Risk.
Background/Issue:	Standing Water, History of Flooding
Ideas for Integration:	Elevate Street, Drainage Improvements
Responsible Agency:	Town of Ocean City/State Highway Administration
Partners:	Town of Ocean City/State Highway Administration
Potential Funding:	Maryland Department of Transportation Grant Hazard Mitigation Assistance
Cost Estimate:	$750K +
Benefits: (Losses Avoided)	Safety, Traffic In/Out to Public Works Complex
Timeline:	TBD
Priority:	HIGH
Worksheet Completed by:	Session #1 – Group #2 – Solid Waste, Worcester County, Parks & Rec, Finance, Construction, and Maintenance Depts.

Table 12-5: Mitigation Strategy Project 3

Jurisdiction/ Responsible Entity:	Town of Ocean City/Public Works
Mitigation Action/Project Title:	Property Protections
Background/Issue:	During Hurricane Sandy in 2012. Flood Water Caused Damage to Transformers Resulting in Extended Periods of Power Loss.
Ideas for Integration:	Higher Elevation or Relocate Transformers
Responsible Agency:	Ocean City Convention Center
Partners:	Public Works – Engineering/Public Works Construction
Potential Funding:	Hazard Mitigation Assistance Maryland Department of Economic Development
Cost Estimate:	Design Needed for Transformer Relocation/Elevation $75K-100K
Benefits: (Losses Avoided)	Loss of Revenue Due to Business Disruption
Timeline:	1-2 Years
Priority:	HIGH
Worksheet Completed by:	

Table 12-6: Mitigation Strategy Project 4

Jurisdiction/ Responsible Entity:	Town of Ocean City
Mitigation Action/Project Title:	Severe Weather Alert and Awareness (to people outside on beach, boardwalk, golf courses, and city parks)
Background/Issue:	Rapidly developing weather event notification (such as, lightning and wind)
Ideas for Integration:	Integrate radio alerts to employees on 800mhz system to sign boards, text alerts, broadcast on boardwalk, FM radio station, city phones, and reverse 9-1-1.
Responsible Agency:	Beach Patrol, Police Department, Communications
Partners:	Town of Ocean City and State Highway Administration Speakers on boardwalk and Parks Software to Link
Potential Funding:	Hazard Mitigation Assistance Warning and Notification
Cost Estimate:	$25K
Benefits: (Losses Avoided)	Prevention of loss of like to people outside during extreme weather events.
Timeline:	6 Months
Priority:	HIGH
Worksheet Completed by:	March 8th Group – 10:30 AM Session

Table 12-7: Mitigation Strategy Project 5

Jurisdiction/ Responsible Entity:	Town of Ocean City
Mitigation Action/Project Title:	Storm Surge
Background/Issue:	Mitigation using inlet dredging and beach nourishment/dune construction to minimize storm damage
Ideas for Integration:	Work with US Army Corps of Engineers
Responsible Agency:	USACE and Town of Ocean City
Partners:	NPS Town of Ocean City – Engineering Worcester County
Potential Funding:	Federal/State/Local
Cost Estimate:	Federal Project On-going Maintenance Costs Associated with Project
Benefits: (Losses Avoided)	Storm surge impacts to downtown will be minimized
Timeline:	Scheduled for 2017-2018
Priority:	HIGH
Worksheet Completed by:	HMPC Members

12.6 Additional Hazard Mitigation Actions & Projects of Special Interest

Additional Mitigation Actions developed as part of the Plan update and draft Plan review were developed. These actions and projects are of special interest for mitigation.

Action: All-Hazards
Continue Hazard Mitigation Plan Integration with other Ocean City planning documents.
Priority Ranking: High
Project: The Ocean City Comprehensive Plan is undergoing an update in 2016-17. Information from the Hazard Mitigation Plan should be integrated into the City Comprehensive Plan Update. In addition, 2016 mitigation strategies should be reviewed in reference to other City planning documents, such as the Capital Improvement Plan and the Transportation Plan. As appropriate, mitigation strategies-actions and projects should be incorporated into City planning documents and ordinance updates, as a matter of standard operation procedure for updating planning documents. In addition, amend Zoning Ordinance to include the new FEMA DFIRM within Chapter 38-FLOODS, Article II, Section 38-31 –Definitions and rules of construction. Finally replace flood zone language within ordinance to reflect July 2015 FEMA DFIRM.

Action: Flood & Coastal Hazards
Decrease flood insurance cost for Ocean City policy-holders.
Priority Ranking: High
Project: Earn Community Rating System (CRS) points. Submit the 2016 Ocean City Hazard Mitigation Plan for CRS audit under the 500 Series-Activity 500: Repetitive Loss Strategy and Activity510: Floodplain Management Planning.

Action: Flood & Coastal Hazards
Conduct a focused flood hazard analysis and planning document.
Priority Ranking: Medium
Project: Obtain FEMA grant funding to complete a Flood Mitigation Plan, focusing on both severe repetitive loss and repetitive loss areas that were designated as part of the Hazard Mitigation Plan Update.

Action: Repetitive Loss Strategies
Prioritize repetitive loss areas 1 and 2 for hazard mitigation, see Appendix A: NFIP & CRS.
Priority Ranking: High
Project: Repetitive Loss Areas 1 and 2 should be prioritized for hazard mitigation. The three (3) severe repetitive loss properties has been given top priority as a mitigation action item and is rated as a “High” priority within the 2016 Mitigation Strategies portion of the Plan. Additionally, an annual outreach project targeting repetitive loss and severe loss properties has also been included as a “High” priority.

Action: Winter Storm
Damage Report and review of current Code
Priority Ranking: Low
Project: Review available damage reports to ensure that current code (Roof Snow Load – 20 psf, frost line depth – 18 inches, and winter design temperature -18) is adequate to mitigate winter storm impacts.

Action: Flood & Coastal Hazards
Review high risk properties including repetitive loss properties identified in the planning document for potential mitigation projects.
Priority Ranking: High
Project: The plan outlines several divisions that are at high risk to flood specifically Division 1 and Division 3. In addition, the two designated repetitive loss areas identified within Appendix A of the Plan should reviewed and prioritized for potential mitigation projects.

Chapter 13 – Review and Adopt the Plan

13.1 Review of Draft Plan

Review and plan revisions have occurred throughout the plan development process. Hazard data was reviewed and discussed during the Kickoff meeting. Hazard identification, ranking results, critical facilities, and public outreach were main topics at the Midpoint meeting. Capability assessment, safe growth audit, Hazus results, and outreach strategies were reviewed and discussed at the three-session Plan Development Workshops. Both the Maryland Emergency Management Agency and the Hazard Mitigation Planning Committee were provided the plan on June 30, 2016 for review and comment. Plan revisions were completed in August 2016.

13.2 Plan Adoption

To public meetings were held during the plan development process. The first public meeting was held on ??? at City Hall. The second public meeting was held on ??? at City Hall. Formal adoption of the plan occurred on ??? by the Mayor and City Council.

13.3 Annual Review

The Disaster Mitigation Action of 2000 requires local hazard mitigation plans to be monitored, evaluated, and updated during the 5-year plan cycle. Local Emergency Planning Committee (LEPC) meets quarterly during the 5-year cycle to monitor and evaluate mitigation strategies and to keep the plan current. Bi-annual status reports will be completed detailing the progress of various mitigation activities. Copies of the bi-annual report will be made available on the Town's website.

The hazard mitigation plan is to be updated and readopted at the end of each 5-year cycle. In the event of a significant disaster or any substantial changes in land use or regulations that impact mitigation efforts, more frequent updates may be required. The Department of Planning and Community Development will be responsible for overseeing the update of the hazard mitigation plan. This would include participation by LEPC.

13.4 Implementation

The Disaster Mitigation Action of 2000 requires that the City implement the plan through existing programs. This can be accomplished through inclusion of mitigation measures in the Comprehensive Plan, land use and building codes, and the floodplain ordinance as detailed in Appendix B: Safe Growth Audit. As these documents are updated, reference to hazard mitigation can be amended into various City plans and regulations. Grant programs that assist in the implementation of mitigation strategies are identified in Appendix D: Funding Sources.

Section 4 – Community Resiliency

TASK 9	Create a Safe and Resilient Community	Chapter 14 Community Resiliency

Section 4 – Community Resilience is a new section added during the 2017 Plan development process. Recognizing that hazard mitigation is the foundation of community resiliency, is an important next step in creating an updated plan for the Town of Ocean City. Resiliency is the capability to quickly "bounce back" from a disaster event. Expanding beyond the idea of creating a disaster-resistant community to include a disaster-resistant and resilient community results in a safer place to live, work and play.

Chapter 14-Community Resiliency

COMMUNITY RESILIENCY

Resilience is the capacity of individuals, communities, businesses, institutions, and governments to adapt to changing conditions and to prepare for, withstand, and rapidly recover from disruptions to everyday life, such as hazard events. Resilience enables communities to adapt to change so that they not only "bounce back" from a disaster, but "bounce forward" to a safer state.

Communities can engage in mitigation efforts both before and after a disaster to become more resilient. This requires addressing not only the physical and environmental impacts of hazards, but also the economic and social impacts.

Mitigation is the foundation of community resilience and touches all parts of a community: how floodplains and natural resources are managed, how a community builds, and where infrastructure and critical facilities are placed.

The Town of Ocean City Maryland is poised to further advance resilience via policy, planning, and action.

14.1 Presidential Directives (PPD 8 & 21)

Presidential Policy Directive (PPD) 8: National Preparedness (2011) defines resilience as the ability to "adapt to changing conditions and withstand and rapidly recover from disruption due to emergencies."

Presidential Policy Directive (PPD) 21: National Preparedness (2013) defines resilience as the ability to "prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions."

14.2 Areas of Interest for Mitigation & Community Resiliency

In order to adapt to changing conditions and prepare for, withstand, and rapidly recover from disruptions to everyday life caused by hazard events, special consideration and emphasis should be placed on:

- Coastal Structures;
- Flow Constrictions;
- At-Risk Critical Facilities:
- Repetitive Loss Areas;
- Land Use Changes;
- Emergency Routes During Frequently Flood Events; and
- Coastal Erosion Areas and Changing Future Conditions, such as Sea Level Rise.

14.2.1 Coastal Structures

Coastal Structures, such as Ocean City's seawall, is used to stabilize the shoreline to mitigate and prevent flood losses. As with other infrastructure such as roads and bridges, regular maintenance of the seawall and other flood and/or erosion protection measures is essential to ensure that they continue to provide the protection necessary for community resilience.

14.2.2 Flow Constrictions

Constrictions occur when a human-made structure, such as a culvert or bridge, constricts the flow of water. Structures not designed properly of in need of maintenance can back water up causing flooding. If the constriction is at a bridge or culvert, these structures could become washed out or overtopped, causing areas to become isolated and potential evacuation issues. Replacement of undersized culverts or improperly designed/installed structures should be prioritized and undertaken to ensure safety, and the continuation of structure use before, during, and after a storm event.

14.2.3 At-Risk Critical Facilities

Essential facilities sometimes referred to as "critical facilities" are those whose impairment during a flood could cause significant problems to individual or communities. The impairment of an essential facility can result in a significant hardship on a community not only during and event but long afterwards, as well.

14.2.4 Repetitive Loss Areas & Additional CRS Points

Understanding geographically where flood assistance has been provided may cast light on unique flood problems. Clusters of past flooded properties may indicate an area of significant issue(s). Looking more closely at these areas and prioritizing flood mitigation and prevention will help the community address ongoing issues. In order to assist in this effort, a new appendix to the Plan was added; Appendix A: NFIP & CRS. This appendix is for official use only as it contains flood insurance data specifically to private property, including repetitive loss properties, which is protected under the Privacy Act. There are thirty-four (34) repetitive loss properties identified within Ocean City. These properties were plotted on a map along with depth of flooding to determine repetitive loss areas. Two (2) repetitive loss areas were identified. Through the identification of these repetitive loss areas, Ocean City is eligible to receive additional CRS points.

Ocean City is eligible to receive additional CRS points through the completion of the Hazard Mitigation Plan. Hazard mitigation planning requirements under 44 CFR Part 201 are consistent with the Community Ration System (CRS) 10-step planning process found within Activity 510 of the CRS Coordinators Manual. A checklist containing CRS planning steps under Activity 510 and the location within the 2017 Hazard Mitigation Plan, where these steps were completed, has been completed within Appendix A.

14.2.5 Land Use Changes

Development may result in loss of flood storage areas, increased impervious surfaces, and in coastal areas, changes in land uses can affect wave hazards beyond the immediate are of the land use change.

14.2.6 Emergency Routes During Frequent Flood Events

Routes are not always elevated above estimated flood levels, and present a significant flood risk for motorist during a flood event. Closure of at-risk routes during an event and identification of alternate routes for motorists reduces risk to life and economic loss. Routes that are frequently overtopped and are identified for emergency evacuation should be assessed for road elevation and reinforcement.

14.2.7 Coastal Erosion Areas and Changing Future Conditions, such as Sea Level Rise

Coastal shorelines erode in response to wave and water level conditions and other factors. As sea levels rise, erosion rates will increase without pro-active management actions. (See EPA report #230-10-85-013 Potential Impacts of Sea Level Rise on the Beach at Ocean City, Maryland, October 1985). Sea level rise considerations and adaptive planning practices are necessary for community resiliency.

According to the current USACE projections, it is prudent to plan for relative sea-level rise of 9.6 inches by 2050 in order to accommodate the intermediate estimate for regional factors particular to Ocean City, Maryland. Based on the various methodologies available today, along with local observations, it is very unlikely to rise more than one foot within a 37-year timeframe. This elevation would constitute an increase in mean sea level, on top of which storm surge (or FEMA base flood elevation) would have to be factored in, to judge the risks to land based facilities.

14.2.8 Funding Sources and Opportunities for Collaboration

Coastal shorelines erode in response to wave and water level conditions and other factors. As sea level rise, erosion is exasperated. Sea level rise considerations and adaptive planning practices are necessary for community resiliency. According to *2013 Updating Maryland's Sea-Level Rise Projections* document, it is prudent to plan for relative sea-level rise of 2.1 feet by 2050 in order to accommodate the high end of the National Research Council (NRC) projections as adjusted for regional factors particular to Maryland. Based on the various methodologies available today, it is very unlikely to rise more than that within that timeframe. This would essentially constitute an increase in mean sea level, on top of which storm surge would have to be factored in, to judge the risks to land-based facilities.

Maryland Department of Natural Resources - Chesapeake and Coastal Services Programs and Resources:

- **Chesapeake & Atlantic Coastal Bays Trust Fund**
  The Chesapeake and Atlantic Coastal Bays Trust Fund is one of the region's most important funding tools targeting water quality, and watershed restoration and protection projects to reduce non-point source pollution. The goal of BayStat each year is to identify projects and develop a work plan designed to maximize the Trust Fund's environmental return on investment, thereby serving as a model of restoration financing efficiency and effectiveness critical to achieving the goals under EPA's Total Maximum Daily Load (TMDL) requirements within the State's Watershed Implementation Plan (WIP). These investments also create green jobs, and provide habitat, mitigate flood hazards, and prevent soil erosion. For more information, contact Jenn Raulin at jennifer.raulin@maryland.gov or (410) 260-8745.

- **Watershed Assistance Collaborative**
  The Watershed Assistance Collaborative is a partnership that provides services and technical assistance to communities to advance restoration activities and projects. By leveraging resources of existing programs, the Watershed Assistance Collaborative exists to provide coordinated capacity building opportunities to local implementers. Communities interested in undertaking comprehensive watershed protection and restoration activities are encouraged to take advantage of the services offered through this partnership. The Collaborative offers the tools, resources and outreach needed to work toward large nonpoint source pollution implementation and restoration efforts. For more information, contact Jenn Raulin at jennifer.raulin@maryland.gov or (410) 260-8745.

- **Innovative Technology Fund**
  The Innovative Technology Fund is accelerating Bay restoration through the development of new technologies. At the 2007 Chesapeake Bay Program Executive Council (EC) meeting, the State of Maryland and the Environmental Protection Agency (EPA) agreed to promote investments in technologies that could accelerate Bay restoration efforts. The Innovative Technology Fund is made possible through funding from Maryland's Chesapeake and Atlantic Coastal Bays Trust Fund and the Environmental Protection Agency (EPA) in partnership with the University of Maryland's Industrial Partnership (MIPS) and the Mtech Ventures Chesapeake Bay Seed Capital Program (Mtech). Additional technical assistance is provided by Maryland DNR and the Chesapeake & Coastal Service. For more information, contact Sarah Lane at sarah.lane@maryland.gov or (410) 260-8726.

Habitat Restoration and Conservation Division
Provides the restoration science and services that State and local partners so urgently need in order to meet their water quality and habitat restoration priorities. For more information, contact Kevin Smith at kevinm.smith@maryland.gov or (410) 260-8797.

- **Natural Filters**
  CCS leads the effort for implementing the Natural Filters on Public Lands Two-Year Milestone. This effort includes the identification of "Natural Filters" projects on all public lands (federal, state, local) and provides technical assistance and funding to those who are eligible to implement on-the-ground restoration in the form of riparian buffers (grass and trees), wetlands, reforestation, and other forms of bio-remediation. For more information, contact Kristen Fleming at kristen.fleming@maryland.gov or (410) 260-8813.

- **Shoreline Conservation Service**
  The Shoreline Conservation Service provides technical and financial assistance to Maryland property owners in resolving shoreline and stream bank erosion problems. Assistance is provided through site visits and evaluations, problem assessments and recommended solutions. For more information, contact Bhaskar Subramanian at bhaskar.subramanian@maryland.gov or (410) 260-8786.

- **Community Restoration Program**
  The Community Restoration Program works to strengthen public outreach and engagement in on-the-ground restoration as well as increase locally led restoration projects. Staff provides assistance to local governments, watershed groups and community organizations in aligning restoration efforts with the Chesapeake Bay TMDL effort and Watershed Implementation Plan goals.
  For more information, contact Claudia Donegan
  at claudia.donegan@maryland.gov or (410) 260-8768.

- **Maryland's Ecosystem Enhancement (ME^2)**
  The ME^2 program provides a better model for mitigation in the State by targeting our limited resources (funding) towards mitigation that enhances Bay Restoration. CCS staff works with other state agencies to construct agricultural BMP's in areas targeted as having a high ecological value, thereby providing the best practice (BMP) in the best location and accelerating restoration. For more information, contact Kristen Fleming at kristen.fleming@maryland.gov or (410) 260-8813.

Coastal and Marine Assessment Division

Assists state and local partners to make effective decisions and plan for future development, conservation and restoration of coastal resources while reducing vulnerability to future storm events, shoreline change and sea level rise. For more information, contact Catherine McCall at catherine.mccall@maryland.gov or (410) 260-8737.

- **Maryland's Coastal Zone Management Program**
  Maryland's Coastal Zone Management Program (Coastal Program) was established through an Executive Order and approved by NOAA in 1978. The

Coastal Program is a networked program and is comprised of several state planning and regulatory programs, as well as the Chesapeake and Coastal Bays Critical Areas Protection Program. The Department of Natural Resources is the lead agency. Maryland's coastal boundary follows the inland boundary of the counties (and Baltimore City) bordering the Atlantic Ocean, Chesapeake Bay, and the Potomac River (as far as the municipal limits of Washington, D.C.).
For more information, contact Catherine McCall
at catherine.mccall@maryland.gov or (410) 260-8737.

- ***CoastSmart* Program**
  Maryland's *CoastSmart* Program is helping local communities identify and implement strategies to protect life and property vulnerable to coastal hazards and climate change. From hands-on training and planning tools to financial resources, *CoastSmart* is ensuring that local communities have the tools that they need to identify and take the necessary actions to become ready, adaptive and resilient to the impacts of climate change. For more information, contact Kate Skaggs at kate.skaggs@maryland.gov or (410) 260-8743.

- ***CoastSmart* Communities Grants**
  Coastal damage The *CoastSmart* Communities Grant (CCG) provides financial assistance to local governments to encourage the incorporation of coastal hazards, sea level rise, and/ or related coastal management issues into local long-term strategic planning, new or modified codes and ordinances, permitting processes, education and outreach campaigns, and other relevant programs. For more information, contact Kate Skaggs at kate.skaggs@maryland.gov or (410) 260-8743.

- **Chesapeake Bay National Estuarine Research Reserve (CBNERR)**
  Maryland's Chesapeake Bay National Estuarine Research Reserve (CBNERR-MD) was established in 1985 with Monie Bay, a large wetland near Deal Island on the lower Eastern Shore, being the sole component. In 1990 Otter Point Creek and Jug Bay were added to the reserve. Together, these three reserve components reflect the diversity of estuarine systems found within the Maryland portion of the Chesapeake Bay providing essential habitat for commercially as well as recreationally important fish and crabs, filtering mud from the Bay's murky waters, and protecting the shoreline from flooding. CBNERR-MD promotes educational opportunities and scientific study of these estuarine systems so that we can better manage and successfully restore these important habitats, as well as enjoy a healthy and productive Bay. For more information, contact Catherine McCall at catherine.mccall@maryland.gov or (410) 260-8737.

- **CBNERR-MD Stewardship Program**
  The Chesapeake Bay National Estuarine Research Reserve (CBNERR) Stewardship Program is integrated with both the research and education programs and its activities focus on monitoring the flora and fauna and managing the components natural resources. Stewardship is the act of protecting the

environment through conservation and restoration. Stewardship at CBNERR-MD involves the long-term protection of thousands of acres of estuarine land and water in our most precious resource, the Chesapeake Bay. Stewardship activities at CBNERR-MD are designed to demonstrate best management practices that other resource professionals, local decision-makers, and the general public can apply in their own communities. For more information, contact Chris Snow at chris.snow@maryland.gov or (410) 260-8731.

- **Coastal Training Program (CTP)**
  The Coastal Training Program provides science based knowledge to community leaders and decision makers to promote clean and healthy streams, rivers, and watersheds of the Chesapeake Bay. CTP provides trainings that bridge science, policy and management in a pertinent, relevant manner which transfers necessary skills and information to planners & other resource managers. CTP is administered by the Chesapeake Bay National Estuarine Research Reserve-MD which is part of the Maryland Department of Natural Resources and NOAA. We are a federal-state-local partnership. For more information, contact Sasha Lane at sasha.land@maryland.gov or (410) 260-8718.

- **Coastal & Estuarine Land Conservation Program (CELCP)**
  CELCP is a nationally-competitive land conservation program through NOAA that was established to protect important coastal and estuarine areas that have significant conservation, recreation, ecological, historical or aesthetic values. Each year, Maryland's Chesapeake & Coastal Program can submit up to three project proposals each with a requested funding of $3,000,000 per project and 1:1 match. Project proposals support coastal land conservation goals outlined in the state's CELCP plan. Since 2008, Maryland has received approximately $16,482,100 from. Maryland is using CELCP funding to protect important coastal and estuarine areas with significant conservation, recreation, ecological, historical, or aesthetic values that may be vulnerable to conversion.

Conservation Education and Stewardship Division

Provides leadership in the Department's efforts to enhance the natural resources stewardship ethic of all Maryland citizens.

- **Aquatic Resources Education Program**
  The Aquatic Resource Education Program is part of the Department of Natural Resources' Chesapeake and Coastal Service. The goal of Maryland's Aquatic Resource Education (ARE) Program is to instill the respect for the aquatic resources and rights of others by cultivating ethical behavior of Maryland's aquatic resources. Maryland's ARE Program enables students to develop an appreciation and understanding of aquatic habitats in Maryland. For more information, contact Cindy Etgen at cindy.etgen@maryland.gov or (410) 260-8716.

- **TEAM DNR**
  TEAM DNR is a volunteer program dedicated to educating elementary and middle school students about the Chesapeake Bay and other natural resource issues in Maryland. TEAM DNR is a volunteer program dedicated to educating elementary and middle school students about the Chesapeake Bay and other natural resource issues in Maryland. TEAM DNR volunteers come from different backgrounds and all have a strong desire to help students understand and care for their natural environment. Their efforts provide an important link between DNR and schools around the State. For more information, contact Chris Hintz atchristine.hintz@maryland.gov or (410) 260-8809.

- **CBNERR-MD Education Program**
  The Chesapeake Bay National Estuarine Research Reserve (CBNERR) Education Program strives to share the results of research happening within the research reserve as well as estuaries throughout the nation. The program provides field experiences for students (pre-school through college), educators and public audiences. The programs are designed to enhance participant's awareness and understanding of estuaries and emphasize the interrelationships of coastal habitats and human activities. Field program activities include the exploration of wetlands and salt marsh, submerged aquatic vegetation, shallow water habitats, collection of fish, crabs and other invertebrates as well as water quality and watershed studies. For more information, contact Coreen Weilminster at coreen.weilminster@maryland.gov or (410) 260-8744.

Geospatial Information and Analysis
Provides DNR, citizens, government agencies and partners with effective and efficient GIS data and tools for analysis and decision-making related to Chesapeake, coastal and ocean planning and management. For more information, contact Kevin Coyne at kevin.coyne@maryland.gov or (410) 260-8985.

- **Maryland's Coastal Atlas**
  The Coastal Atlas is an online mapping and planning tool that allows state and local decision-makers to explore data for coastal and ocean planning activities. The data available through the Coastal Atlas includes physical characteristics, human uses and ecological resources. Through the Coastal Atlas, users are able to visualize, query, map, and analyze available data to better manage our marine and estuarine resources. The tools currently available, and those that will be continually developed for the Coastal Atlas, are designed to support better decision-making by transforming available data into information tailored for specific issues. For more information, contact Chris Cortina at christopher.cortina@maryland.gov or (410) 260-8774.

- **MERLIN Online**
  MERLIN Online, or Maryland's Environmental Resources and Land Information Network, allows users to produce a custom map of any location in Maryland, including their choice of base maps and data layers. MERLIN Online takes

advantage of the latest technologies to ensure the user has the best mapping experience with the most recent data available. For more information, contact Kevin Coyne atkevin.coyne@maryland.gov or (410) 260-8985.

14.3 Community Long-term Resiliency Goals

Long-tern resiliency goals include:

- Attracting business investment;
- Expansion of recreation facilities while addressing the need to make appropriate use of land at risk for flooding;
- Strengthening the ability of Ocean City government and its critical facilities to function after hazard events;
- Developing processes and guidelines for post-event assessments and repairs that will accelerate the evaluation process, including the designation of building that can be “used during repair” after an event;
- Collaborating with adjacent jurisdictions for mutual aid during response and recovery phase;
- Developing education and awareness programs to enhance understanding, preparedness, and opportunities for community resilience;
- Ensuring that key transportation routes and bridges remain serviceable;
- Engage the seafood industry in resilience discussions. Work collaboratively with Delaware and Virginia resources to improve efficiencies within this industry as a preparatory step to a formal resilience plan;
- Include the State Manufacturing Extension Partnership program and University Industrial Assessment Centers in resiliency discussions; and
- Explore renewable energy opportunities within Ocean City, especially solar that would provide for additional energy storage capacity (batteries associated with solar collection) that could be tapped in times of need due to storm events and longer term sea level rise events.

14.4 Sustainable Ocean City

Coastal Resources Legislative Committee “Green Team”

The Coastal Resources Legislative Committee was established in 2001 as a forum to help keep the Mayor and City Council informed of issues and concerns that would impact the environmental and natural resources of the Town.

Ocean City has recently attained the designation as a Sustainable Maryland Certified community through an initiative of the Environmental Finance Center at the University of Maryland. The program is designed to support Maryland’s 157 municipalities as they look for cost-effective and strategic ways to protect their natural assets and revitalize their communities. Using best practices in resource areas like water, energy, planning, health, food, and economy, a municipality can earn points toward sustainability certification.

The Green Team will continue to coordinate with Hazard Mitigation Plan efforts and will serve as a resource for plan elements which deal with community resiliency.

Figure 14-1: Sustainable Ocean City

Sustainable Ocean City Website Content Includes:

Buying Local Why???
- Re-circulate purchasing dollars
- Potentially increases tax revenues
- Enhance the livability of the community
- Brings stability and diversity to the local economy
- Job creation
- Reduction of greenhouse emissions as consumers travel less

Farmers Markets
Ocean City – Ocean Pines – Berlin
http://www.visitmaryland.org/article/maryland-farmers-markets?gclid=CPipmoan_sYCFQ2PHwodgEED8g#worcester

Local Business Directories
The **Hotel Motel Restaurant Association** and the **Ocean City Chamber of Commerce** have local business directories at the following links:
- HMRA buyers Guide
- Chamber Members

Energy
Trash to Energy – Recycling
Just a different way of thinking and doing recycling!
http://oceancitymd.gov/oc/departments/public-works/recycling/
Recycling Dilemma
This is an interesting article on the evolution of recycling and problem and issues that have arised.

Natural Resources
Watershed Stewardship
Homeowners Guide to the Coastal Bays
This awesome informational publication.
Maryland Coastal Bays Comprehensive Conservation Management Plan
Maryland Coastal Bays Native Plants
http://www.mdcoastalbays.org/content/docs/Native_Plants_of_Worcester_County.pdf
Chesapeake Native Plants
http://www.nps.gov/plants/pubs/chesapeake/pdf/chesapeakenatives.pdf
Ocean City is Certified Maryland Healthy Business
Beach clean ups
Earth Day – April annually
International Coastal Clean Up – September annually
http://www.oceanconservancy.org/our-work/international-coastal-cleanup/clean-up-locations.html
Dune Patrol (Adopt a Dune Program)

Appendix A:
NFIP & CRS

OFFICIAL USE ONLY

Ocean City, MD

2017

Appendix B:
Safe Growth Audit

Ocean City, MD

2017

This page is intentionally blank.

INTRODUCTION

Generally described as the routine consideration and management of hazard risks in your community's existing planning framework – plan integration is the collection of plans, policies, codes, and programs that guide development in your community, how those are maintained and implemented, and the roles of people, agencies, and departments in evaluating and updating them. Effective integration of hazard mitigation occurs when your community's planning framework leads to develop patterns that do not increase risks from known hazards or leads to redevelopment that reduces risk from known hazards.

SAFE GROWTH AUDIT

During the preparation of the *2017 Town of Ocean City Hazard Mitigation Plan*, a Safe Growth Audit was conducted. Performing a Safe Growth Audit is a way to assess how well the existing planning tools address hazard risks and community resiliency. Safe Growth Audit questions provide a systematic way to review local planning tools and identify the presence of, or need for, hazard-related actions.

The goal of SAFE GROWTH is to build environments that are safe for current and future generations and to protect building, transportation, utilities, and the natural environment from damage.

Local documents reviewed during the Safe Growth Audit include:

- Draft Comprehensive Plan;
- Zoning Ordinance;
- Subdivision of Land;
- 2011 Hazard Mitigation Plan; and
- 2014-2015 Capital Improvement Plan.

Plan	Location
COMPREHENSIVE PLAN	
LAND USE	
Does the future land-use map clearly identify natural hazard areas?	Map 3-2: Map not in Comprehensive Plan to review.
Do the land-use policies discourage development or redevelopment within hazard areas?	Yes. Chapter 3: Land Use and Community Character Conservation and Protection of Sensitive Areas Page 3-13 Chapter 7: Sensitive Areas and Environmental Protection Pages 7-1 thru 7-27
Does the Plan provide adequate space for expected future growth in areas located outside natural hazard areas?	Map 3-2: Map not in Comprehensive Plan to review.
TRANSPORTATION	
Does the transportation plan limit access to hazard areas?	No
Is the transportation policy used to guide growth to safe locations?	Yes Chapter 7: Transportation
Are movement systems designed to function under disaster conditions (e.g., evacuation)?	Yes Continue improvements to Route 90. The City should continue to pursue the dualization and Construction of a new road and bridge entering Ocean City somewhere North of 100th Street Page 4-8 On the Town of Ocean City website under Emergency Management/Know Your Zone: View interactive maps and evacuation plan.
ENVIRONMENTAL MANAGEMENT	
Are environmental systems that protect development from hazard identified and mapped?	Yes Chapter 7: Sensitive Areas and Environmental Protection Sensitive Areas: Steams and their buffers, 100-year floodplains, habitats of threatened and endangered species, steep slopes, coastal bays and buffers, wetlands and tidal/non-tidal buffers, dunes, and beaches Page 7-3 Chapter 9: Implementation Environmental Resource Management Page 9-6 thru 9-7
Do environmental policies maintain and restore protective ecosystems?	Yes Chapter 7: Sensitive Areas and Environmental Protection

Plan	Location
Do environmental policies provide incentives to development that is located outside of protective ecosystems?	Yes Chapter 7: Sensitive Areas and Environmental Protection Plan Goal: *To protect the quality of the air, water and land from adverse effects of development and growth and, where feasible, to enhance the quality of the natural environment and sensitive areas.* Page 7-1 Chapter 3: Land Use and Community Character Future Land Use Plan Page 3-10 thru 3-13
PUBLIC SAFETY	
Are the goals and policies of the comprehensive plan related to the FEMA Local Hazard Mitigation Plan?	Yes Chapter 7: Sensitive Areas and Environmental Protection The Maryland Coastal Bay Program – a joint effort involving Ocean City, Worchester County, the State of Maryland, and the federal government. It is an initiative in 1996 to develop a plan for the protection and preservation of the Coastal Bays. The Town should continue to actively participate in the Program, and implement the recommendations of the Program as they are developed over time. The Beach Replenishment Project – long-term commitment to maintain Ocean City's most valued asset.
Is safety explicitly included in the plan's growth and development policies?	Yes Chapter 3: Land Use and Community Character Sensitive Areas: Maintaining wetlands and beach areas, acting as buffers protecting property from natural hazards and are critical to tourism and sport-fishing industry. Page 3-17 Chapter 4: Transportation Plan Goal: *To maintain and improve the transportation system to accommodate the movement of people and goods as efficiently as possible, with minimum congestion and maximum safety.* Page 4-1 Stormwater management and beautification project in the 1990's which installed medians in Coastal Highway has reduced the number of accidents and improved pedestrian safety. Page 4-5 Improvements to Route 90(Ocean City Expressway) Page 4-8

Plan	Location
Is safety explicitly included in the plan's growth and development policies? *Continued*	Bicycle and Pedestrian Movement Page 4-17 Airport Enhancements Page 4-20Chapter 5: Community Facilities and Public Services Plan Goal*: To provide for the continued maintenance and expansion of community facilities and a complete and efficient system of public services necessary to ensure the health, safety, and welfare of residents and visitors and the economic prosperity of the community.* Page 5-1 Chapter 7: Sensitive Areas and Environmental Protection Solid Waste and Recycling The Ocean Dumping Act of 1972 curtailed many past abuses and funded research to further the understanding of the potential hazards and safety issues. Page 7-16
Does the monitoring and implementation section of the plan cover safe growth objectives??	Yes Chapter 9: Implementation Page -9-2 thru 9-8
ZONING ORDINANCE	
Does the zoning ordinance conform to the comprehensive plan in terms of discouraging development or redevelopment within natural hazard areas?	Yes Zoning – Chapter 110 Division 20 Ocean City, Maryland Code or Ordinances Chapter 110 - Zoning RC-1Resource Conservation District Section 110-781: The RC-1 resource conservation district is intended to preserve and protect the natural character and unique natural resources of Ocean City's wetland areas, including the natural spawning grounds, nursing grounds, feeding grounds and habitats of the valuable sport and commercial fish, waterfowl, and other wildlife resources of Ocean City. The RC-1 district is intended for use in areas which are highly unsuited for development and in which development would have a significant adverse effect on the natural environment and public and private lands which have been set aside for conservation of the natural environment.

Plan	Location
Does the zoning ordinance conform to the comprehensive plan in terms of discouraging development or redevelopment within natural hazard areas? *Continued*	Ocean City, Maryland Code of Ordinances Chapter 30 – Environment *Intent.* In 2002 the Maryland General Assembly passed the Atlantic Coastal Bays Protection Act for the purpose of preserving, protecting, and improving the water quality and natural habitats of the Atlantic Coastal Bays and their tributaries. The Legislature has determined that the Atlantic Coastal Bays require especially sensitive consideration with regard to development. It is the intent of the Mayor and City Council of Ocean City to establish a local program to implement the requirements of the act.
Does the ordinance contain natural hazard overlay zones that set conditions for land use within such zones?	Yes Chapter 3: Land Use and Community Character Overlay Districts/Sensitive Areas Pages 3-15 thru 3-17
Do rezoning procedures recognize natural hazard areas as limits on zoning changes that allow greater intensity or density use?	
SUBDIVISION REGULATIONS	
Do the subdivision regulations restrict the subdivision of land within or adjacent to natural hazard areas?	No
Do the regulations provide for conservation subdivision or cluster subdivisions in order to conserve environmental resources?	Section 30-553 – Intensely Developed Areas (11) Whenever possible, future development in the Atlantic Coastal Bays Critical Area should use cluster development as a means to reduce impervious areas and to maximize areas of natural vegetation. *Note: This is not in Ocean City, Maryland Code of Ordinances Chapter 78 – Subdivisions, it is located in Chapter 30 – Environment.*
Do the regulations allow density transfer where hazard areas exist?	

Plan	Location
CAPITAL IMPROVEMENT PROGRAM AND INFRASTRUCTURE POLICIES	
Does the capital improvement program provide funding for hazard mitigation projects identified in the FEMA Mitigation Plan?	The FY 2014-FY 2018 CIP for the Town of Ocean City includes capital expenditures designed to improve the infrastructure of Ocean City, including several water main upgrades, waterwaste improvements, airport upgrades, and road improvement projects.
Does the capital improvement program limit expenditures on projects that would encourage development in areas vulnerable to natural hazards?	Town of Ocean City, Maryland Capital Improvement Plan – FY2014-FY2018

Source: S&S Planning and Design & HMPC

Appendix C: Sources

Ocean City, MD

2017

This page is intentionally blank.

Introduction

Prepared by Maryland Emergency Management Agency. FEMA Local Mitigation Planning Handbook. 2013.

Section 1

The Town of Ocean City, Maryland Comprehensive Plan. August 2006.

Prepared by Town of Ocean City, Maryland Finance Department. Comprehensive Annual Financial Report; For Fiscal Year Ending June 30, 2014. 2014.

"U.S. Census Bureau-American Fact Finder." Available at: www.census.gov. 2015.

"U.S. Census, 2010-2014 American Community Survey 5-Year Estimate." Available at: www.census.gov. 2015.

Town of Ocean City, Maryland Website. Available at http://oceancitymd.gov. 2016.

Prepared by Federal Emergency Management Agency. FEMA Guide 362-4.

Section 2

Town of Ocean City, Maryland Hazard Mitigation Planning Committee, 2015.

Prepared by Maryland Emergency Management Agency. State of Maryland Local Mitigation Plan Guidance. May 2015.

Prepared by Maryland Emergency Management Agency. State of Maryland Hazard Mitigation Plan. Available at http://www.mema.state.md.us/MEMA/index.jsp. 2016.

National Oceanic and Atmospheric Administration - National Weather Service. National Climatic Data Center – Storm Events. Available at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms. 2015.

2010 & 2015 U.S. Climate Data. Available at http://www.usclimatedata.com/.

Prepared by Town of Ocean City, Maryland GIS Staff. GIS Data Layers. Town of Ocean City, MD: 2015.
Prepared by ESRI. GIS Data Layers - North American Street Map. Environmental Systems Research Institute: 2008.

National Hurricane Center, 2012.

Prepared by Federal Emergency Management Agency (FEMA). GIS Data Layers – Depth Grids. 2015. www.fema.gov.

Prepared by Federal Emergency Management Agency (FEMA). Flood Risk Report; Worcester County, Maryland Coastal Study. December, 30, 2015.

Prepared by DispatchAdmin. The Dispatch; Emergency Beach Replenishment Project Expected in Ocean City, April 4, 2013.

"Fujita Tornado Damage Scale". Available at http://www.spc.noaa.gov/faq/tornado/f-scale.html.

"Definitions of FEMA Flood Zone Designations". Available at http://msc.fema.gov/. 2010

Prepared by Federal Emergency Management Agency (FEMA). GIS Data Layer – Preliminary Digital Flood Insurance Map. 2015.

Prepared by FEMA. National Flood Insurance Report of Maryland. National Flood Insurance Program. Received by Kevin Wager – National Flood Insurance Program Coordinator for the Maryland Department of Natural Resources. 2015.

Repetitive loss properties in Town of Ocean City, Maryland. Received by Kevin Wager – National Flood Insurance Program Coordinator for the Maryland Department of Natural Resources. 2015.

State Climate Office of North Carolina – Impacts on Winter Weather.

Prepared by the Mid-Atlantic Regional Council on the Ocean (MARCO). Climate Change in Sea Level Rise Information Exchange. December 2010.

Prepared by Maryland Emergency Management Agency. FEMA Local Mitigation Planning Handbook. 2013.

Sources Utilized Throughout the Plan

Prepared by Town of Ocean City GIS Staff. GIS Data Layers-Parcels Town of Ocean City, MD: 2015.

Prepared by Town of Ocean City GIS Staff. GIS Data Layers-Town Boundary Town of Ocean City, MD: 2015.

Prepared by Town of Ocean City GIS Staff. GIS Data Layers-Address Points, Town of Ocean City, MD: 2015.

Town of Ocean City, Maryland Website. Available at http://oceancitymd.gov. 2016.

Prepared by Maryland Emergency Management Agency. State of Maryland Hazard Mitigation Plan. Available at http://www.mema.state.md.us/MEMA/index.jsp. 2011.

Prepared by Town of Ocean City, Maryland 2011 All-Hazard Mitigation Plan. July 16, 2012.

Town of Ocean City Hazard Mitigation Planning Committee (HMPC).

The Town of Ocean City, Maryland Comprehensive Plan. August 2006.

Town of Ocean City Municipal Code. Available at https://www.municode.com/library/md/ocean_city/codes/code_of_ordinances. 2015.

Prepared by The Sustainable Maryland Certified Program. 2016.

Appendix D: Funding Sources for Mitigation Projects

Ocean City, MD

2017

This page is intentionally blank.

Note: Updated October, 2015

The following is a list of Federal and State Grants that may assist in implementing local All Hazard Mitigation Plans.

This information is subject to change at anytime, contact the federal or state agency for current grant status.

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
Federal Emergency Management Agency, Hazard Mitigation Grant Program (HGMP)	Maryland Emergency Management Agency 5401Rue Saint Lo Drive Reisterstown, MD 21136	All Hazards Mitigation Planning. Acquisition, relocation, elevation and flood-proofing of flood-prone insured properties, flood mitigation planning, wind retrofit, stormwater improvements, education and awareness.	Federal - 75% Non Federal - 12.5%	Local government must be in compliance with the National Flood Insurance Program to be eligible. Projects must be cost effective, environmentally sound and solve a problem. Repetitive loss properties are a high priority.	After a Presidential Disaster Declaration
Federal Emergency Management Agency, Pre Disaster Mitigation Grant Program (PDM)	Maryland Emergency Management Agency 5401Rue Saint Lo Drive Reisterstown, MD 21136	Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations.	Federal - 75% Non Federal - 25%	PDM grants are to be awarded on a competitive basis and without reference to state allocations, quotas, or other formula-based allocation of funds.	Annual-Spring/Summer
Federal Emergency Management Agency, Flood Mitigation Assistance Program (FMA)	Maryland Emergency Management Agency 5401Rue Saint Lo Drive Reisterstown, MD 21136	Assist States and communities to implement measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program.	RL: Federal - 90% Non Federal - 10% SRL: Federal - 100% Non Federal - 0%	Available once a Flood Mitigation Plan has been developed and approved by FEMA.	Annual-Spring/Summer
National Flood Insurance Program (NFIP)	Maryland Emergency Management Agency 5401Rue Saint Lo Drive Reisterstown, MD 21136	Provides financial protection by enabling persons to purchase insurance against floods, mudslide or flood related erosion.	Varies	Includes Federally backed insurance against flooding, available to individuals and businesses that participate in the NFIP	Anytime

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
Increased Cost of Compliance	Maryland Emergency Management Agency 5401Rue Saint Lo Drive Reisterstown, MD 21136	ICC coverage provides payment to help cover the cost of mitigation activities that will reduce the risk of future flood damage to a building. If a Flood Insurance Policy Holder suffers a flood loss and is declared to be substantially or repetitively damaged, ICC will pay up to 30,000 to bring the building into compliance with State or community floodplain management laws or ordinances. Usually this means elevating or relocating the building so that it is above the base flood elevation (BFE).	Varies	Once the local jurisdiction determines the building is substantially or repetitively damaged, the policy holder can contact insurance agent to file an ICC claim.	Anytime
U.S. Economic Development Administration, Economic Adjustment Program	U.S. Department of Commerce Economic Development Administration Curtis Center, 601 Walnut Street, Ste 140 South Philadelphia, PA 19106-3323 215-597-4603	Improvements and reconstruction of public facilities after a disaster or industry closing. Research studies designed to facilitate economic development.	Federal - 50%-70% Local- 30%-50%	Documenting economic distress, job impact and proposing a project that is consistent with a Comprehensive Economic Development Strategy are important funding selection criteria.	Anytime
U.S Economic Development Administration, Public Works and Development Facilities	U.S. Department of Commerce Economic Development Administration Curtis Center, 601 Walnut Street, Ste 140 South Philadelphia, PA 19106-3323 215-597-4603	Water and sewer, Industrial access roads, rail spurs, port improvements technological and related infrastructure	Federal - 50%-70% Local- 30%-50%	Documenting economic distress, job impact and projects that is consistency with a Comprehensive Economic Development Strategy are important funding selection criteria.	Quarterly Basis
Small Business Administration (SBA) Pre-disaster Mitigation Loan Program	James Rivera, Office of Disaster Assistance, Small Business Administration, 409 3rd Street, SW, STE 6050 Washington, DC 20416;202-205-6734	Activities done for the purpose of protecting real and personal property against disaster related damage.	No information	The mitigation measures must protect property or contents from damage that may be caused by future disasters and must conform to the priorities and goals of the state or local government's mitigation plan.	

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
Community Development Block Grants / States Program	U.S Department of Housing and Urban Development, Office of Block Grant Assistance, 451 7th Street SW., Washington, DC 20410-7000;202-708-1112	Used for long-term recovery needs, such as: rehabilitation residential and commercial building; homeownership assistance, including down-payment assistance and interest rate subsidies; building new replacement housing; code enforcement; acquiring, construction, or reconstructing public facilities.	No information	Citizen participation procedures must be followed. At least 70 percent of funds must be used for activities that principally benefit persons of low and moderate income. Formula grants to States for non-entitlement communities.	After a Presidential Disaster Declaration
Fire Suppression Assistance Program	Infrastructure Division, Response and Recovery Directorate, FEMA, 500 C Street SW., Washington DC 20024 ; 202-646-2500.	Provides real-time assistance for the suppression of any fire on public (non-Federal) or privately owned forest or grassland that threatens to become a major disaster.	Federal - 70% Local - 30%	The State must first meet annual floor cost (if percent of average fiscal year fire costs) on a single declared fire. After the State's out-of-pocket expenses exceed twice the average fiscal year costs, funds are made available for 100 percent of all costs for each declared fire.	Funds from President's Disaster Relief Fund for use in a designated emergency or major disaster area.
Historic Preservation: Repair and Restoration of Disaster-Damaged Historic Properties	Infrastructure Division, Response and Recovery Directorate, FEMA, 500 C Street SW., Washington DC 20024 ; 202-646-4621.	To evaluate the effects of repairs to, restoration of, or mitigation hazards to disaster-damaged historic structures working in concert with the requirements of the Stafford Act.	Federal - 75% Local - 25%	Eligible to State and local governments, and any political subdivision of a State. Also, eligible are private non-profit organizations that operate educational, utility, emergency, or medical facilities.	After a Presidential Disaster Declaration
Transportation: Emergency Relief Program	Federal Transit Authority, FHWA, DOT, 1200 New Jersey Avenue Washington, DC 20590; 202-366-4043	Provides aid for the repair of Federal-aid roads and roads on Federal lands.	Federal - 100%	Application is submitted by the State department of transportation for damages to Federal-aid highway routes, and by the applicable Federal agency for damages to roads on Federal lands.	After serious damage to Federal-aid roads or roads on Federal lands caused by a natural disaster or by catastrophic failure.

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
Animals: Emergency Haying and Grazing	Emergency and Non-insured Assistance Programs, FSA, USDA, 1400 Independence Ave, SW, Washington, DC 20013; 202-720-4053	To help livestock producers in approved counties when the growth and yield of hay and pasture have been substantially reduced because of a widespread natural disaster.	No information	Assistance is provided by the Secretary of Agriculture to harvest hay or graze cropland or other commercial use of forage devoted to the Conservation Reserve Program (CRP0 in response to a drought or other similar emergency.	Anytime
Emergency Watershed Protection Program	Natural Resources Conservation Service 1400 Independence Avenue, SW Washington, DC 20250	Implementing emergency recovery measures for runoff retardation and erosion prevention to relieve imminent hazards to life and property created by a natural disaster that causes a sudden impairment of a watershed.	Federal - 75% Local - 25%	It cannot fund operation and maintenance work or repair private or public transportation facilities or utilities. The work cannot adversely affect downstream water rights and funds cannot be used to install measures not essential to the reduction of hazards.	TBD
Watershed Protection and Flood Prevention Program	Natural Resources Conservation Service 1400 Independence Avenue, SW Washington, DC 20250	To provide technical and financial assistance in carrying out works of improvement to protect, develop, and utilize the land and water resources in watersheds.	Varies due to project type.	Watershed area must not exceed 250,000 acres. Capacity of a single structure is limited to 25,000 acre-feet of total capacity and 12,500 acre-feet of floodwater detention capacity.	TBD
Watershed Surveys and Planning	Natural Resources Conservation Service 1400 Independence Avenue, SW Washington, DC 20250	To provide planning assistance to Federal, State, and local agencies for the development of coordinated water and related programs in watersheds and river basins. Emphasis is on flood damage reduction, erosion control, water conservation, preservation of wetlands and water quality improvements.	No information	These watershed plans form the basis for installing needed works of improvement and include estimated benefits and costs, cost-sharing, operation and maintenance arrangements, and other information necessary to justify the need for Federal assistance in carrying out the plan.	Anytime
Emergency Advance Measures for Flood Prevention	USACE 441 G Street, NW, Washington DC 20314; 202-761-0011	To perform activities prior to flooding or flood fight that would assist in protecting against loss of life and damages to property due to flooding.	No information	There must be an immediate threat of unusual flooding present before advance measures can be considered. Any work performed under this program will be temporary in nature and must have a favorable benefit cost ratio.	Governor of State must request assistance

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
Emergency Streambank and Shoreline Protection	USACE 441 G Street, NW, Washington DC 20314; 202-761-0011	Authorizes the construction of emergency streambank protection measures to prevent damage to highways, bridge approaches, municipal water supply systems, sewage disposal plants, and other essential public works facilities endangered by floods or storms due to bank erosion.	No information	Churches, hospitals, schools, and other non-profit service facilities may also be protected under this program. This authority does not apply to privately-owned property or structures.	TBD
Small Flood Control Projects	USACE 441 G Street, NW, Washington DC 20314; 202-761-0011	Authorizes the construction of small flood control projects that have not already been specifically authorized by Congress.	No information	There are two general categories of projects: structural and nonstructural. Structural projects may include levees, floodwalls, diversion channels, pumping plants, and bridge modifications. Nonstructural projects have little or no effect on water surface elevations, and may include flood proofing, the relocation of structures, and flood warning systems.	TBD
Flood: Emergency Advance Measures for Flood Prevention	USACE 441 G Street, NW, Washington DC 20314; 202-761-0011	To mitigate, before an event, the potential loss of life and damages to property due to floods.	No information	Assistance may consist of temporary levees, channel cleaning, preparation for abnormal snowpacks, etc.	Governor of State must request assistance
Continuing Authorities Program (CAP)	USACE 441 G Street, NW, Washington DC 20314; 202-761-0011	Initiates a short reconnaissance effort to determine Federal interest in proceeding. If there is interest, a feasibility study is preformed.	Federal - 65% Local-35%	A local sponsor must identify the problem and request assistance. Small flood control projects are also available.	Anytime
Hazardous Materials: State Access to the Oil Spill Liability Trust Fund	Director, USCG National Pollution Funds Center, U.S. Coast Guard Stop 7605 2703 Martin Luther King Jr. Avenue, SE Washington, DC 20593-7605 202-795-6000	To encourage greater State participation in response to actual or threatened discharges of oil.	No information	Eligible to States and U.S. Trust Territories and possessions.	Anytime

Grant Program Name	Address and Telephone Contact Information	Eligible Activities	Federal, State and Local Cost Share Requirements	Other Program Characteristics	Grant Application Due Date
Emergency Management Assistance (EMA)	Maryland Emergency Management Agency 5401Rue Saint Lo Drive Reisterstown, MD 21136	Funds may be used for salaries, travel expenses, and other administrative cost essential to the day-to-day operations of State and Local emergency management agencies. Program also includes management processes that ensure coordinated planning, accountability for progress, and trained qualified staffing.	Federal - 50%	EMA funded activities may include specific mitigation management efforts not otherwise eligible for Federal funding. Management Assistance program funds may not be used for construction, repairs, equipment, materials or physical operations required for damage mitigation projects for public or private buildings, roads, bridges, or other facilities.	Anytime

Appendix E: Critical Facilities & Hazus Methodology

Ocean City, MD

2017

This page is intentionally blank.

The following methodology was utilized to prepare the critical facilities for incorporation into the Hazus program. Subsequently is the methodology for conducting Hazus Flood and Hurricane Wind loss estimate analyses.

- **Critical Facilities**
  - Replacement of default data within the HAZUS Maryland Database
  - Referred to as "Essential Facilities" within HAZUS
  - 5 Classifications:
    - Fire Stations
    - Police Stations
    - Schools
    - Emergency Operations Centers (EOC)
    - Medical Care Facilities
  - Output Results:
    - Building and content losses
    - Functionality assessment (loss of use – how many days not functional)
    - Restoration time to 100% functionality

Table 3.18 Essential Facilities Classification

Hazus Label	Occupancy Class	Description
Medical Care Facilities		
MDFLT	Default Hospital	Assigned features similar to EFHM
EFHS	Small Hospital	Hospital with less than 50 Beds
EFHM	Medium Hospital	Hospital with beds between 50 & 150
EFHL	Large Hospital	Hospital with greater than 150 Beds
EFMC	Medical Clinics	Clinics Labs Blood Banks
Emergency Response		
FDFLT	Default Fire Station	
EFFS	Fire Station	
PDFLT	Default Police Station	
EFPS	Police Station	
EDFLT	Default EOC	
EFEO	Emergency Operation Centers	
Schools		
SDFLT	Default School	Assigned features similar to ESF1
EFS1	Grade Schools Primary/ High Schools	
EFS2	Colleges/Universities	

  - Importing Critical Facility Data
    - Critical Facility Data is requested from Ocean City in the form of an ArcGIS format (shapefiles)
      - Address points
      - Building footprints
      - Data points including facility name
    - MD Property View Data is obtained
    - Utilizing aerial imagery, all data points including MD Property View Data is manually positioned within the building footprint to ensure location accuracy. This also ensures facility name and address match the correct building footprint
    - MD Property View data is joined with local data points to ensure attributes are available for use
    - Once attributes are joined, the attribute table is reviewed and unnecessary data is removed
    - The attribute table is exported to MS Excel for additional attributes necessary for HAZUS Analysis
    - HAZUS requires:
      - Basement

- Foundation Type
- First Floor Elevation
- Design Level (Pre or Post FIRM)
- Number of Stories
- Replacement Cost
- Content Replacement Cost
- Additional information is needed for specific facility types, such as number of students for schools, number of hospital beds,

- Once all information is vetted and correct, the file is imported into HAZUS CDMS for replacement of default data within the HAZUS Maryland Database.

- **HAZUS Coastal Flood Methodology**
  - FEMA's HAZUS program is utilized to determine coastal flood losses for the 1-percent-annual-chance flood event.
  - User defined data (and Critical Facilities) will be imported into HAZUS for the coastal flood risk product. In order to accomplish this, the following steps are completed:
    - Develop depth grids using the high resolution digital elevation model (DEM) and FIRM Zones AE and VE with a static base flood elevation (BFE) from effective Digital Flood Insurance Rate Maps (DFIRM).
      - Flood depths are obtained by subtracting the water surface from the ground elevation; hence depth grids.
    - Develop user defined facility inventory.
      - User defined inventory includes: Essential Facilities and all other facilities designated as "Critical" by Ocean City. This method is detailed above.
    - Conduct HAZUS Coastal Flood Analysis.
      - Depth Grids and User Defined Facilities are imported and program is run for analysis.

- **HAZUS Hurricane Wind Methodology**
  - FEMA's HAZUS program assesses the impacts from hurricane wind by utilizing a hazard-load-resistance-damage-loss methodology.
  - User defined data (and Critical Facilities) will be imported into HAZUS for the hurricane wind analysis. In order to accomplish this, the following steps are completed:
    - Define the scenario for the study region.
      - Deterministic Hurricane Hazard is selected. Activating the Deterministic hurricane hazard will allow the user to select a historical storm and modify it to show an alternate outcome (more direct impact).

- Develop user defined facility inventory.
  - User defined inventory includes: Essential Facilities and all other facilities designated as “Critical” by Ocean City. This method is detailed above.
- Conduct HAZUS Hurricane Wind Analysis.
  - Select Historical Storm and modify track and wind speeds.
  - User Defined Facilities are imported and program is run for analysis.

The following table details the Critical Facilities analyzed within the Plan update.

SITE NAMES & ADDRESSES- TOWN OF OCEAN CITY	
SITE NAMES	**ADDRESS**
Radio Tower- Ocean Pines	11123 Racetrack Road
Park & Ride Station- West OC	12848 Ocean Gateway
Keyser Yard	10104 Keyser Point Road
Life Saving Museum- Artifact Storage	10104 Keyser Point Road
Municipal Airport- Localizer	12724 Airport Road
Municipal Airport- Main Terminal	12724 Airport Road
Municipal Airport- Maintenance Hangar	12724 Airport Road
Animal Shelter	12330 Eagles Nest Road
Eagles Landing- Club House	12367 Eagles Nest Road
Eagles Landing- Maintenance Bldg	8828 Bald Eagle Lane
Tram Storage & Office- Whiteside	703 South Philadelphia Avenue
Water Well Field- Worcester Street	101 Worcester Street
Radio Tower- Worcester Street	601A South Philadelphia Avenue
Beach Patrol HQ	107 Dorchester Street
Fire Station 2	102 Dorchester
Wastewater Pump Station # 1	100 St. Louis Avenue
Skate Park Office	300 3rd Street
Comfort Station- 9th Street	900 Atantic Avenue
Water Plant- 15th Street	1400 St. Louis Avenue
Tram/ Comfort Station- North Boardwalk	2701 Atlantic Avenue
Convention Center	4001 Coastal Highway
Wastewater Pump Station # 4	607 32nd Street
Water Well House- 51st Street	5102 Coastal Highway
Tennis Center	6101 Coastal Highway
Wastewater Complex- Bldg 0300 (Effluent Pump Station)	6405 Seabay Drive

SITE NAMES	ADDRESS
Wastewater Complex- Bldg 0900 (Maintenance Bldg)	6405 Seabay Drive
Wastewater Complex- Bldg 1200 (DAF/ Thickener Bldg)	6405 Seabay Drive
Wastewater Complex- Bldg 1400 (Oxygen Reactors)	6405 Seabay Drive
Wastewater Complex- Bldg 1800 (Oxygen Bldg)	6405 Seabay Drive
Wastewater Complex- Bldg 2600 (Chemical Bldg)	6405 Seabay Drive
Wastewater Complex- Bldg 2800 (Equalizer Bldg)	6405 Seabay Drive
Wastewater Complex- Bldg 3100 (Lab Bldg)	6405 Seabay Drive
Wastewater Complex- Bldg 3200 (Lime Stabilization Bldg)	6405 Seabay Drive
Wastewater Complex- Bldg 3300 (Biolsolids Bldg)	6405 Seabay Drive
Wastewater Complex- Office Bldg	6405 Seabay Drive
Beach Patrol Substation- 66th Street	118 66th Street
Public Works Complex- Bldg A (Purchasing/ Service Ctr)	204 65th Street
Public Works Complex- Bldg B (Bus Washing Facility)	204 65th Street
Public Works Complex- Bldg C (Support Shops)	204 65th Street
Public Works Complex- Bldg D (Electronic Services)	204 65th Street
Public Works Complex- Bldg E (Admin Offices)	204 65th Street
Public Works Complex- Bldg F (Tansportation Operations Center)	204 65th Street
Public Works Complex- Bldg G (Tansportation Bus Storage)	204 65th Street
Public Works Complex- Bldg H (Vehicle Storage)	204 65th Street
Public Works Complex- Bldg I (Recycle Bldg)	204 65th Street
Public Works Complex- Bldg J (Transfer Station)	204 65th Street
Public Works Complex- Fire Pump Room	204 65th Street
Public Works Complex- Guard Booth	204 65th Street
Fire Station 3	7401 Coastal Highway
Wastewater Pump Station # 5	503 Arctic Ave
Wastewater Pump Station # 6	199 Old Landing Road
Water Pump Station- 100th Street	105 100th Street
Wastewater Pump Station # 7	101 Jamestown Road
Northside Park- Parks Building	12801 Jamaica Avenue
Northside Park- Home Run Café	200 125th Street
Northside Park- Recreation Complex	200 125th Street
Northside Park- Soccer Field House	200 125th Street
Fire Station 4	12925 Coastal Highway
Wastewater Pump Station # 8	13004 Sinepuxent Ave

SITE NAMES	ADDRESS
Water Plant- Gorman Ave	201 137th Street
Radio Tower- Gorman Avenue	202A 136th Street
Wastewater Pump Station #9	14106 Dukes Avenue
OC1 Mobile Command Vehicle Storage Building	123 66th Street
Public Safety- Special Ops Storage Building	123 66th Street
Radio Tower- 66th Street	203A 66th Street
Public Safety Building	6501 Coastal Highway
Sunset Room	200 42nd St. (Bayside)
Fire Station 5	10124 Keyser Point Road
City Hall	301 Baltimore Avenue
Wastewater Pump Station # 12	5 Sunset Island Drive
Fire Station 1	1409 Philadelphia Avenue
Water Plant- 44th Street	104 44th Street
Transit Station- North End	100 144th Street
Transit Station- South End	100 South Division Street
Boardwalk Information Cottage/Comfort Station - Caroline Street	11 South Atlantic Avenue
Beach Patrol Substation- 130th Street	12904 Wight Street
Comfort Station- Caroline Street	3 South Atlantic Avenue
Water Well House- 38th Street	3801 Coastal Highway
Comfort/ Police Substation- Worcester Street	501 South Atlantic Avenue
Tram Station- South Boardwalk	801 South Atlantic Avenue
Life Saving Museum	813 South Atlantic Avenue
Eastern Shore Gas Distribution System	115 67th Street (Bayside)
Verizon Land Line System Building	604 St. Louis Avenue
Tower designation 1st St.	210 First Street
Tower designation South End	601 S. Philadelphia
Tower designation 41st. St.	104 41st. Street
Tower designation 64th St.	301 64th Street
Tower designation 94th St.	402 94th Street
Tower designation Gorman Ave	202 136th Street
Ocean City Substation	303 2nd Street
Maridel Substation	102 41st Street
Ocean Bay Substation	105 85th Street
138th Street Substation	205 138th Street
Comcast Building	8301 Coastal Hwy

Appendix F: Hazus Hurricane Wind

Ocean City, MD

2017

Hazus-MH: Hurricane Event Report

Region Name: OC

Hurricane Scenario: Scenario-26Apr2016

Print Date: Friday, April 29, 2016

Disclaimer:
Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

Table of Contents

General Description of the Region

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The hurricane loss estimates provided in this report are based on a region that includes 1 county(ies) from the following state(s):

- Maryland

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 4.65 square miles and contains 1 census tracts. There are over 3 thousand households in the region and has a total population of 7,232 people (2000 Census Bureau data). The distribution of population by State and County is provided in Appendix B.

There are an estimated 9 thousand buildings in the region with a total building replacement value (excluding contents) of 2,752 million dollars (2006 dollars). Approximately 92% of the buildings (and 83% of the building value) are associated with residential housing.

Building Inventory

General Building Stock

Hazus estimates that there are 9,560 buildings in the region which have an aggregate total replacement value of 2,752 million (2006 dollars). Table 1 presents the relative distribution of the value with respect to the general occupancies. Appendix B provides a general distribution of the building value by State and County.

Table 1: Building Exposure by Occupancy Type

Occupancy	Exposure ($1000)	Percent of Tot
Residential	2,288,982	83.2%
Commercial	401,745	14.6%
Industrial	20,158	0.7%
Agricultural	567	0.0%
Religious	33,224	1.2%
Government	6,305	0.2%
Education	871	0.0%
Total	**2,751,852**	**100.0%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds. There are no schools, 5 fire stations, 3 police stations and 1 emergency operation facilities.

Hurricane Scenario

Hazus used the following set of information to define the hurricane parameters for the hurricane loss estimate provided in this report.

Scenario Name: Scenario-26Apr2016

Type: Deterministic

Maximum Peak Gust in Study Region: 70 mph

User Defined Storm Track Input Data

Point	Latitude	Longitude	Time Step (hour)	Translation Speed (mph)	Radius To Max Winds (miles)	Max. Sustained Wind Speed (mph @ 10m)	Cental Pressure (mBar)	Profile Parameter	Radius to Hurricane Force Winds (miles)
1	35.40	-76.60	292.00	--	--	90.40	957.00	--	88.55
2	37.33	-77.34	294.00	--	--	90.40	959.00	--	88.55
3	39.49	-77.66	296.00	--	--	90.40	960.00	--	74.69
4	40.68	-77.92	298.00	--	--	83.32	965.00	--	0.00

Building Damage

General Building Stock Damage

Hazus estimates that about 10 buildings will be at least moderately damaged. This is over 0% of the total number of buildings in the region. There are an estimated 0 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 6 of the Hazus Hurricane technical manual. Table 2 below summarizes the expected damage by general occupancy for the buildings in the region. Table 3 summarizes the expected damage by general building type.

Table 2: Expected Building Damage by Occupancy

	None		Minor		Moderate		Severe		Destruction	
Occupancy	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	8	99.38	0	0.59	0	0.03	0	0.00	0	0.00
Commercial	609	99.29	4	0.70	0	0.02	0	0.00	0	0.00
Education	3	99.29	0	0.70	0	0.01	0	0.00	0	0.00
Government	8	99.26	0	0.73	0	0.01	0	0.00	0	0.00
Industrial	99	99.26	1	0.73	0	0.01	0	0.00	0	0.00
Religion	46	99.41	0	0.57	0	0.02	0	0.00	0	0.00
Residential	8,685	98.89	88	1.00	9	0.10	1	0.01	0	0.00
Total	**9,457**		**93**		**9**		**1**		**0**	

Table 3: Expected Building Damage by Building Type

Building	None		Minor		Moderate		Severe		Destruction	
Type	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Concrete	229	98.82	3	1.17	0	0.01	0	0.00	0	0.00
Masonry	2,195	97.44	52	2.30	6	0.25	0	0.00	0	0.00
MH	1,798	100.00	0	0.00	0	0.00	0	0.00	0	0.00
Steel	440	99.08	4	0.91	0	0.01	0	0.00	0	0.00
Wood	4,813	99.59	17	0.36	2	0.04	0	0.01	0	0.00

Essential Facility Damage

Before the hurricane, the region had no hospital beds available for use. On the day of the hurricane, the model estimates that 0 hospital beds (0%) are available for use. After one week, none of the beds will be in service. By 30 days, none will be operational.

Table 4: Expected Damage to Essential Facilities

		# Facilities		
Classification	**Total**	**Probability of at Least Moderate Damage > 50%**	**Probability of Complete Damage > 50%**	**Expected Loss of Use < 1 day**
EOCs	1	0	0	1
Fire Stations	5	0	0	5
Police Stations	3	0	0	3

Induced Hurricane Damage

Debris Generation

Hazus estimates the amount of debris that will be generated by the hurricane. The model breaks the debris into four general categories: a) Brick/Wood, b) Reinforced Concrete/Steel, c) Eligible Tree Debris, and d) Other Tree Debris. This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 895 tons of debris will be generated. Of the total amount, 16 tons (2%) is Other Tree Debris. Of the remaining 879 tons, Brick/Wood comprises 85% of the total, Reinforced Concrete/Steel comprises of 0% of the total, with the remainder being Eligible Tree Debris. If the building debris tonnage is converted to an estimated number of truckloads, it will require 30 truckloads (@25 tons/truck) to remove the building debris generated by the hurricane. The number of Eligible Tree Debris truckloads will depend on how the 133 tons of Eligible Tree Debris are collected and processed. The volume of tree debris generally ranges from about 4 cubic yards per ton for chipped or compacted tree debris to about 10 cubic yards per ton for bulkier, uncompacted debris.

Social Impact

Shelter Requirement

Hazus estimates the number of households that are expected to be displaced from their homes due to the hurricane and the number of displaced people that will require accommodations in temporary public shelters. The model estimates 1 households to be displaced due to the hurricane. Of these, 0 people (out of a total population of 7,232) will seek temporary shelter in public shelters.

Economic Loss

The total economic loss estimated for the hurricane is 3.2 million dollars, which represents 0.12 % of the total replacement value of the region's buildings.

Building-Related Losses

The building related losses are broken into two categories: direct property damage losses and business interruption losses. The direct property damage losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the hurricane. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the hurricane.

The total property damage losses were 3 million dollars. 0% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 98% of the total loss. Table 4 below provides a summary of the losses associated with the building damage.

Table 5: Building-Related Economic Loss Estimates

(Thousands of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Property Damage						
	Building	2,681.42	64.96	2.02	7.42	2,755.82
	Content	166.41	0.00	0.00	0.00	166.41
	Inventory	0.00	0.00	0.00	0.00	0.00
	Subtotal	**2,847.83**	**64.96**	**2.02**	**7.42**	**2,922.23**
Business Interruption Loss						
	Income	0.00	0.00	0.00	0.00	0.00
	Relocation	129.17	0.53	0.02	0.06	129.80
	Rental	143.05	0.00	0.00	0.00	143.05
	Wage	0.00	0.00	0.00	0.00	0.00
	Subtotal	**272.23**	**0.53**	**0.02**	**0.06**	**272.85**
Total						
	Total	**3,120.06**	**65.50**	**2.04**	**7.48**	**3,195.08**

Appendix A: County Listing for the Region

Maryland
- Worcester

Appendix B: Regional Population and Building Value Data

	Population	Building Value (thousands of dollars)		
		Residential	Non-Residential	Total
Maryland				
Worcester	7,232	2,288,982	462,870	2,751,852
Total	**7,232**	**2,288,982**	**462,870**	**2,751,852**
Study Region Total	**7,232**	**2,288,982**	**462,870**	**2,751,852**

Appendix G:
Hazus Flood: Coastal

Ocean City, MD

2017

Hazus-MH: Flood Event Report

Region Name: OCHMP

Flood Scenario: OC

Print Date: Thursday, May 19, 2016

Disclaimer:

Totals only reflect data for those census tracts/blocks included in the user's study region.

The estimates of social and economic impacts contained in this report were produced using Hazus loss estimation methodology software which is based on current scientific and engineering knowledge. There are uncertainties inherent in any loss estimation technique. Therefore, there may be significant differences between the modeled results contained in this report and the actual social

Table of Contents

Hazus is a regional multi-hazard loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). The primary purpose of Hazus is to provide a methodology and software application to develop multi-hazard losses at a regional scale. These loss estimates would be used primarily by local, state and regional officials to plan and stimulate efforts to reduce risks from multi-hazards and to prepare for emergency response and recovery.

The flood loss estimates provided in this report were based on a region that included 1 county(ies) from the following state(s):

- Maryland

Note:
Appendix A contains a complete listing of the counties contained in the region.

The geographical size of the region is 5 square miles and contains 484 census blocks. The region contains over 4 thousand households and has a total population of 7,232 people (2000 Census Bureau data). The distribution of population by State and County for the study region is provided in Appendix B.

There are an estimated 9,560 buildings in the region with a total building replacement value (excluding contents) of 2,752 million dollars (2006 dollars). Approximately 91.86% of the buildings (and 83.18% of the building value) are associated with residential housing.

General Building Stock

Hazus estimates that there are 9,560 buildings in the region which have an aggregate total replacement value of 2,752 million (2006 dollars). Table 1 and Table 2 present the relative distribution of the value with respect to the general occupancies by Study Region and Scenario respectively. Appendix B provides a general distribution of the building value by State and County.

Table 1
Building Exposure by Occupancy Type for the Study Region

Occupancy	Exposure ($1000)	Percent of Total
Residential	2,288,982	83.2%
Commercial	401,745	14.6%
Industrial	20,158	0.7%
Agricultural	567	0.0%
Religion	33,224	1.2%
Government	6,305	0.2%
Education	871	0.0%
Total	**2,751,852**	**100.00%**

Table 2
Building Exposure by Occupancy Type for the Scenario

Occupancy	Exposure ($1000)	Percent of Total
Residential	1,910,294	81.4%
Commercial	380,883	16.2%
Industrial	17,417	0.7%
Agricultural	507	0.0%
Religion	30,268	1.3%
Government	6,305	0.3%
Education	871	0.0%
Total	**2,346,545**	**100.00%**

Essential Facility Inventory

For essential facilities, there are no hospitals in the region with a total bed capacity of no beds.
There are no schools, 5 fire stations, 3 police stations and 1 emergency operation center.

Hazus used the following set of information to define the flood parameters for the flood loss estimate provided in this report.

Study Region Name:	OCHMP
Scenario Name:	OC
Return Period Analyzed:	100
Analysis Options Analyzed:	No What-Ifs

General Building Stock Damage

Hazus estimates that about 203 buildings will be at least moderately damaged. This is over 16% of the total number of buildings in the scenario. There are an estimated 39 buildings that will be completely destroyed. The definition of the 'damage states' is provided in Volume 1: Chapter 5.3 of the Hazus Flood Technical Manual. Table 3 below summarizes the expected damage by general occupancy for the buildings in the region. Table 4 summarizes the expected damage by general building type.

Table 3: Expected Building Damage by Occupancy

	1-10		11-20		21-30		31-40		41-50		Substantially	
Occupancy	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Agriculture	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Commercial	2	22.22	5	55.56	0	0.00	2	22.22	0	0.00	0	0.00
Education	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Government	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Industrial	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Religion	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Residential	0	0.00	40	20.41	60	30.61	19	9.69	38	19.39	39	19.90
Total	**2**		**45**		**60**		**21**		**38**		**39**	

Table 4: Expected Building Damage by Building Type

Building Type	1-10		11-20		21-30		31-40		41-50		Substantially	
	Count	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**	**Count**	**(%)**
Concrete	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ManufHousing	0	0.00	0	0.00	7	14.89	0	0.00	1	2.13	39	82.98
Masonry	0	0.00	7	23.33	10	33.33	3	10.00	10	33.33	0	0.00
Steel	2	33.33	4	66.67	0	0.00	0	0.00	0	0.00	0	0.00
Wood	0	0.00	34	28.57	43	36.13	16	13.45	26	21.85	0	0.00

Before the flood analyzed in this scenario, the region had 0 hospital beds available for use. On the day of the scenario flood event, the model estimates that 0 hospital beds are available in the region.

Table 5: Expected Damage to Essential Facilities

		# Facilities		
Classificatio	Total	At Least Moderate	At Least Substantial	Loss of Use
Fire Stations	5	1	0	1
Hospitals	0	0	0	0
Police Stations	3	2	0	1
Schools	0	0	0	0

If this report displays all zeros or is blank, two possibilities can explain this.

(1) None of your facilities were flooded. This can be checked by mapping the inventory data on the depth grid.

(2) The analysis was not run. This can be tested by checking the run box on the Analysis Menu and seeing if a message box asks you to replace the existing results.

Debris Generation

Hazus estimates the amount of debris that will be generated by the flood. The model breaks debris into three general categories: 1) Finishes (dry wall, insulation, etc.), 2) Structural (wood, brick, etc.) and 3) Foundations (concrete slab, concrete block, rebar, etc.). This distinction is made because of the different types of material handling equipment required to handle the debris.

The model estimates that a total of 15,095 tons of debris will be generated. Of the total amount, Finishes comprises 71% of the total, Structure comprises 13% of the total. If the debris tonnage is converted into an estimated number of truckloads, it will require 604 truckloads (@25 tons/truck) to remove the debris generated by the flood.

Shelter Requirements

Hazus estimates the number of households that are expected to be displaced from their homes due to the flood and the associated potential evacuation. Hazus also estimates those displaced people that will require accommodations in temporary public shelters. The model estimates 887 households will be displaced due to the flood. Displacement includes households evacuated from within or very near to the inundated area. Of these, 1,680 people (out of a total population of 7,232) will seek temporary shelter in public shelters.

The total economic loss estimated for the flood is 164.72 million dollars, which represents 7.02 % of the total replacement value of the scenario buildings.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 161.31 million dollars. 2% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 52.82% of the total loss. Table 6 below provides a summary of the losses associated with the building damage.

Table 6: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	52.81	22.59	0.77	0.68	76.85
	Content	33.41	44.57	1.06	4.84	83.87
	Inventory	0.00	0.37	0.22	0.00	0.60
	Subtotal	**86.22**	**67.52**	**2.05**	**5.51**	**161.31**
Business Interruption						
	Income	0.11	1.24	0.00	0.03	1.37
	Relocation	0.10	0.24	0.00	0.01	0.35
	Rental Income	0.28	0.18	0.00	0.00	0.46
	Wage	0.29	0.77	0.00	0.17	1.23
	Subtotal	**0.78**	**2.42**	**0.00**	**0.21**	**3.41**
ALL	**Total**	**87.00**	**69.94**	**2.05**	**5.73**	**164.72**

Appendix A: County Listing for the Region

Maryland

- Worcester

Appendix B: Regional Population and Building Value Data

		Building Value (thousands of dollars)		
	Population	Residential	Non-Residential	Total
Maryland				
Worcester	7,232	2,288,982	462,870	2,751,852
Total	**7,232**	**2,288,982**	**462,870**	**2,751,852**
Total Study Region	**7,232**	**2,288,982**	**462,870**	**2,751,852**

Appendix H: HMPC Meeting Minutes

Ocean City, MD

2017

Ocean City Maryland
Hazard Mitigation Planning Committee

Meeting/Project Name:	**Ocean City Hazard Mitigation Planning Committee Kick-off Meeting**		
Date of Meeting:	21 July 2015	**Time:**	2:00-4:00pm
Meeting Facilitator:	Virginia Smith, S&S Planning and Design	**Location:**	City Hall, 3rd Street Ocean City, MD

Meeting Topics

- **Introductions**
- **Ocean City Hazard Mitigation Plan**
- **Hazard Mitigation Plan Update Process**
- **New Hazard Data & Discussion**
- **New Hazard Identification**
- **New Hazard Ranking**
- **New Plan Items**
- **Next Steps**

Hazard Mitigation Planning Committee Members

Name	Department		Name	Department
Joe Theobald	Emergency Services		Tim Price	Fire Department
Bob Rhode			Blaine Smith	Planning & Community Development
Janet Guiton			Karen Zera	
Ross Fowle			Scott Kirkpatrick	Police Department
Kevin R. Brown	Chief Building Official		Scott Harner	
Larry Noccolino	Convention Center		Roger Steger	Public Works
Terry McGean	Engineering		Calvin Ginnavan	Recreation & Parks
Dawn Leonard	Finance		Al Handy	
Martha Bennett			Joe Perry	
James Deptula			Eric Lagstrom	Risk/Claims Manager
Chuck Birely			Donna Abbott	Tourism

Introductions

Bob Rhode, Emergency Management Planner/Coordinator, welcomed the participants to the meeting. He informed the group that the City had obtained grant funding to complete the update to the *2011 Ocean City, Maryland All-Hazards Mitigation Plan*. The City hired S&S Planning and Design, to assist in the Hazard Mitigation Plan Update development.

Mr. Rhode introduced Virginia Smith and Michele King, S&S Planning and Design. Participant introductions were made providing S&S staff with a wide range of agency/organizations from which to work and obtain local information. Participants were informed they will comprise the Hazard Mitigation Planning Committee (HMPC), which is necessary to satisfy the hazard mitigation planning requirements.

Ocean City Hazard Mitigation Plan & Update Process

Mrs. Smith reviewed the *2011 Ocean City, Maryland All-Hazards Mitigation Plan* with committee members. An overview of the update process was explained to the HMPC. The three main components in the update process include: hazard identification and risk ranking, vulnerability analysis and mitigation strategies. Mrs. Smith explained that as chapters are developed, they will be distributed to the HMPC for review and comment. Questions specific to plan format were posed. Mr. Rhode stated the Ocean City COOP Plan and EOP formatting should be followed. Mr. Rhode will provide the template.

New Hazard Data & Discussion

Ocean City hazard data from the National Climatic Data Center (NCDC) was distributed for review. Data tables distributed were specific to Ocean City along with Presidential Declarations. This information will be added to the Plan Update.

New Hazard Identification & Ranking

Chapter III-Hazard Identification, pages 28-29, of the *2011 Ocean City, Maryland All-Hazards Mitigation Plan* were provided for discussion. Table 5-Summary of Hazard Risks for Ocean City was reviewed by the group. As a result of discussion, hazards identified in the Plan Update will include:

- Flash Flood
- Coastal Flooding
- Hurricane/Tropical Storm
- Nor'easter
- Shoreline Erosion
- Sea Level Rise
- Winter Storm
- High Wind
- Tornado
- Extreme Heat
- Thunderstorm (Lightning & Hail)
- Brush Fire
- Epidemic
- Transportation (Airplane & HazMat)

A fillable PDF Hazard Risk Ranking form will be provided to Mr. Rhode for distribution. The Committee results will be compiled and incorporated into the new 2016 Plan Update.

New Plan Items

New plan items discussed for inclusion into the 2016 Plan Update included:

- Plan Integration Chapter – Safe Growth Audit
- Community Rating System (CRS) – 510 Planning Activities
- New Enhanced Hazus Hurricane Wind for vulnerability analysis to be completed by S&S
- Integration of Worcester County Coastal Risk Map and data from pending MDE/MEMA initiative

Information Request

- CRS Audit – Previous breakdown of points obtained for planning activities
- Comprehensive Plan
- Municipal Growth Element, if available
- Zoning Ordinance
- Subdivision Ordinance
- Capital Improvement Plan
- Evacuation and/or Shelter Plan(s)
- GIS Data

Next Steps

- Plan Chapter Distribution: Throughout Planning Process
- Midpoint Planning Meeting – October 2015
- Mitigation Strategies Planning Meeting – November 2015
- Draft HMP completed – December 2015
- MEMA/FEMA/Local Comment Period – January/February 2016
- MEMA/FEMA Approval – January/February 2016
- Adoption of Ocean City Hazard Mitigation Plan Update – March 2016

Ocean City Maryland
Hazard Mitigation Planning Committee

Meeting/Project Name:	**Ocean City Hazard Mitigation Planning Committee October Meeting**		
Date of Meeting:	22 October 2015	**Time:**	2:00-4:00pm
Meeting Facilitator:	Virginia Smith, S&S Planning and Design	**Location:**	Public Safety Building-EOC Room

Meeting Topics

- **Review of Kick-off Meeting Minutes**
- **Hazard Identification & Ranking Results**
- **Plan Mapping Products-Division Map for Planning Areas**
- **Work Session**
  - **Capability Assessment**
  - **Infrastructure Related Issues**
  - **Mitigation Action Report**
- **Planning Process timeline**

Hazard Mitigation Planning Committee Members

Name	Department		Name	Department
Joe Theobald Bob Rhode Michael Collins	Emergency Services		Tim Price	Fire Department
			Blaine Smith Karen Zera Bill Neville	Planning & Community Development

Review of 21 July 2015

Meeting minutes where approved as read.

Hazard Identification & Ranking Results

Following the Kick-off meeting a fillable PDF Hazard Risk Ranking form was distributed to the HMPC members. The Committee results were compiled and incorporated into the new 2016 Plan Update and presented at the 22 October 2015meeting.
Hazards ranked as **"High"** include: Coastal Flooding, Hurricane/Tropical Storm, and Nor'easter.
Hazards ranked as **"Medium High"** include: Shoreline Erosion, Sea Level Rise, and High Wind.
Hazards ranked as **"Medium"** include: Winter Storm, and Thunderstorm (Lightning & Hail).
Hazards ranked as **"Medium Low & Low"** include: Flash Flood, Tornado, Extreme Heat, Brush Fire, Epidemic, and Transportation related accidents.

Plan Mapping Products

S&S staff met with members from the Office of Emergency Management and Planning and Community Development on 30 September 2016. During the meeting staff concluded that the (5) Division Maps used by the Office of Emergency Management for planning and evacuation purposes should be used in the 2016 Ocean City Hazard Mitigation Plan as planning areas. Dividing the Town of Ocean City into the five divisions or planning areas will enable the viewer to see a higher level of detail on mapping products within the Plan Update document.

S&S staff reviewed the critical facility listing with Mr. Rhode and worked with his office to update the information for his final review on 22 October 2016.

Finally, the vulnerability assessment for both Coastal Flood Risk and Hurricane Wind will be completed using an Enhanced HAZUS Analysis software tool. Results will be incorporated into each of the hazard specific plan chapter including mapping products and data tables. Information such as loss estimations, debris generation and shelter will be added during the Plan Update.

Work Session

Capability Assessment- Each community has a unique set of capabilities, including authorities, policies, programs, staff, funding, and other resources available to accomplish mitigation and reduce long-term vulnerability. S&S staff reviewed the existing capabilities with the planning team in order to identify capabilities that currently reduce disaster losses or could be used to reduce losses in the future, as well as capabilities that inadvertently increase risks in the community. Worksheets were distributed specific to four types of capabilities:

- Planning and Regulatory;
- Administrative and Technical;
- Financial;
- Education and Outreach.

Next, S&S staff posed the following question to HMPC members present:

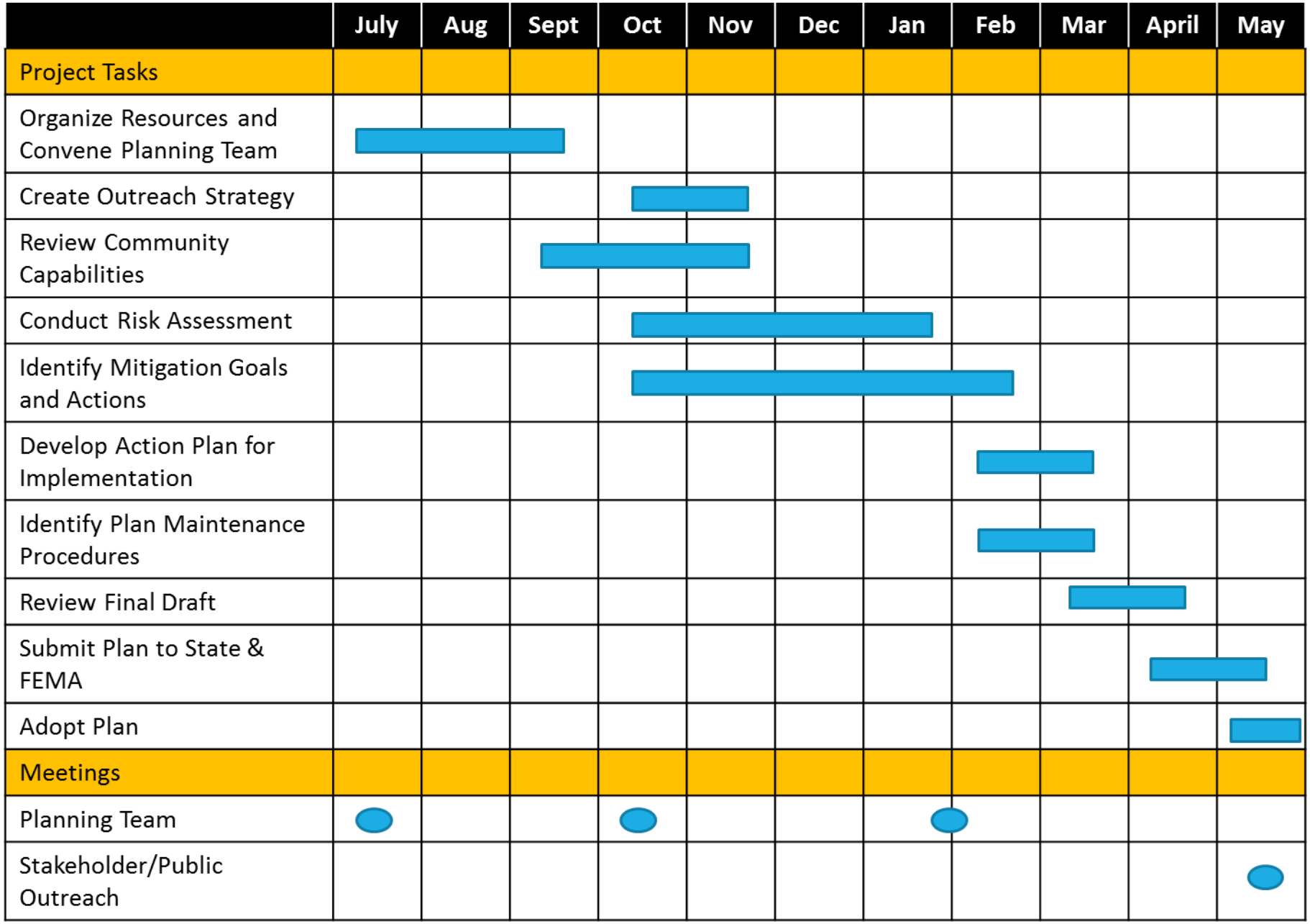
What is the most vulnerable area(s) in Ocean City in terms of flooding?

HMPC members reviewed five large format division street maps. Members were provided with black sharpies and asked to denote areas on the maps that are known areas of repetitive **flood related problems/issues**. S&S will compile results and place on digital mapping products for review and discussion at the next HMPC meeting.

Status Update of 2012 Mitigation Actions detailed within the *Ocean City, Maryland All-Hazards Mitigation Plan* were discussed. A handout was distributed and information will be collected by S&S staff for inclusion in the Plan Update within the Mitigation Strategies Chapter.

Public Outreach

HMPC members discussed a potential public outreach project. A Spring newsletter is distributed to all residents. An article on the Hazard Mitigation Plan update may be inserted into newsletter. Bob Rhode and S&S staff will work with the Town PIO on this project.


July
Aug
Sept
Oct
Nov
Dec
Jan
Feb
Mar
April
May
Project Tasks
Organize Resources and Convene Planning Team
Create Outreach Strategy
Review Community Capabilities
Conduct Risk Assessment
Identify Mitigation Goals and Actions
Develop Action Plan for Implementation
Identify Plan Maintenance Procedures
Review Final Draft
Submit Plan to State & FEMA
Adopt Plan
Meetings
Planning Team
Stakeholder/Public Outreach

Ocean City Maryland
Hazard Mitigation Planning Committee

Meeting/Project Name:	**Ocean City Hazard Mitigation Planning Committee March Meeting - Draft Materials Workshop**		
Date of Meeting:	8 March 2016	**Time:**	Group 1 – 8:30am Group 2 – 10:30am Group 3 – 1:30pm
Meeting Facilitator:	Virginia Smith, S&S Planning and Design	**Location:**	Ocean City Beach Patrol 109 Talbot Street 2nd Floor Training Rm

Meeting Topics

- **Planning Process**
  - **Review of October Workshop**
  - **March – (3) Sessions**
- **Capability Assessment - Review**
  - **Planning and Regulatory**
  - **Administration and Technology**
  - **Education and Outreach**
  - **Financial**
- **Hazus Review**
- **Mitigation Strategies – Development**
  - **Prevention**
  - **Property Protection**
  - **Public Education and Awareness**
  - **Natural Resource Protection**
  - **Emergency Services**
  - **Structural Projects**
- **Review Outreach Strategies**
- **Next Steps**
  - **Prioritize Mitigation Strategies**
- **Develop Draft Plan Document for Hazard Mitigation Planning Committee Review**

Hazard Mitigation Planning Committee Members Hazard Mitigation Draft Materials Workshop Group 1: 0830-1030 Hours				
Name	**Department**		**Name**	**Department**
Tom Kane	Worchester County		Steven Brown	Public Works
Bob Dimaio Amanda Lewis W. M. Collins Bob Rhode	Ocean City Emergency Services		Roger Steger Woody Vickers	Public Works Construction
Calvin Ginnauvan	Parks & Recreation		James Deptua	Finance
Reatta Tate	Ocean City Convention Center		Thomas Dy	Public Works Maintenance
Pam McMillian	Procurement			

Hazard Mitigation Planning Committee Members Hazard Mitigation Draft Materials Workshop Group 2: 1030-1230 Hours				
Name	**Department**		**Name**	**Department**
Joe Perry	Recreation & Golf		Mike Keiser	Electronics
Bob Rhode Michael Collins Amanda Lewis	Ocean City Emergency Services		Martin Bennett	Finance
Karen Zera	Planning & Zoning		Brian L. Scarborough	Public Works Solid Waste
Ward Kovacs	Ocean City Beach Patrol			

Hazard Mitigation Planning Committee Members Hazard Mitigation Draft Materials Workshop Group 3: 1330-1530 Hours				
Name	**Department**		**Name**	**Department**
Bill Neville	Planning		Scot Wells	Communications
Brian Connor	Transportation		Donna Abbott	Tourism
Catrice Parsons	Purchasing		Betsy Campbell	Human Resources
Bob Rhode Amanda Lewis	Ocean City Emergency Services		Tim Price Amanda Bunting	Fire

Review of 22 October 2015
Meeting minutes where approved as read.

Introductions
Bob Rhode, Emergency Management Planner/Coordinator, welcomed the participants to the meeting. He introduced Virginia Smith and Michele King, S&S Planning and Design. Virginia Smith reviewed the hazard mitigation planning process to any new committee members.

Capability Assessment

Updated Capability Assessment handouts were provided for review. Each group introduced themselves to the committee. Any new information provided by committee members was collected.

S&S staff reviewed and discussed the Safe Growth Audit with the planning committee.

- Session 1
    - Bob Rhodes stated a Strategic Plan Update was completed on March 9, 2016 and he will provide.

Hazus Review

Ms. King reviewed FEMA's HAZUS vulnerability assessment software to new members and provided additional detailed information on the Enhanced HAZUS Analysis. The Coastal Flood Risk data results were discussed. Mapping and data tables were reviewed during each of the meeting sessions. Ms. King explained that Non-Regulatory Coastal Flood Risk Product was developed through a planning initiative completed by MDE and MEMA. This initiative was completed at the County level. In order to assess Ocean City in a more detailed assessment, Ms. King utilized the software to run a new Enhanced HAZUS Analysis for Ocean City. Next, Ms. King discussed Critical Facilities and their location in regards to the depth grid. Numerous facilities were located within the depth grid including Fire Station #2. Ms. King continued by providing mapping depicting the Evacuation Zones in relation to the flood depth grid. Ms. King also provided a map illustrating the flood related issues discussed and provided by the HMPC during the Midpoint Meeting. Specific areas of concern were pointed out to the Committee. These areas included: Division 1, specifically the entire west side of Coastal Highway; Division 2, bayside structures located between 51st Street and 52nd Street; Division 3, bayside development between Arctic and Bering Streets; and Division 4, bayside development between 112th Street and Old Landing Road and between 132nd Street and 136th Street. Maps and data reviewed during the meeting were highlights, however, expanded information and full study reports will be distributed to the committee and incorporated into the 2016 Plan document. Hazus Hurricane Wind results and reports will also be distributed to the committee and incorporated in the Plan document.

- Session 1
    - Members stated Fire Station #2 was elevated and flooding has not occurred at this facility.
- Session 2
    - Members identified new Critical Facilities for inclusion in the analysis. Bob Rhodes will provide names and addresses for new facilities.

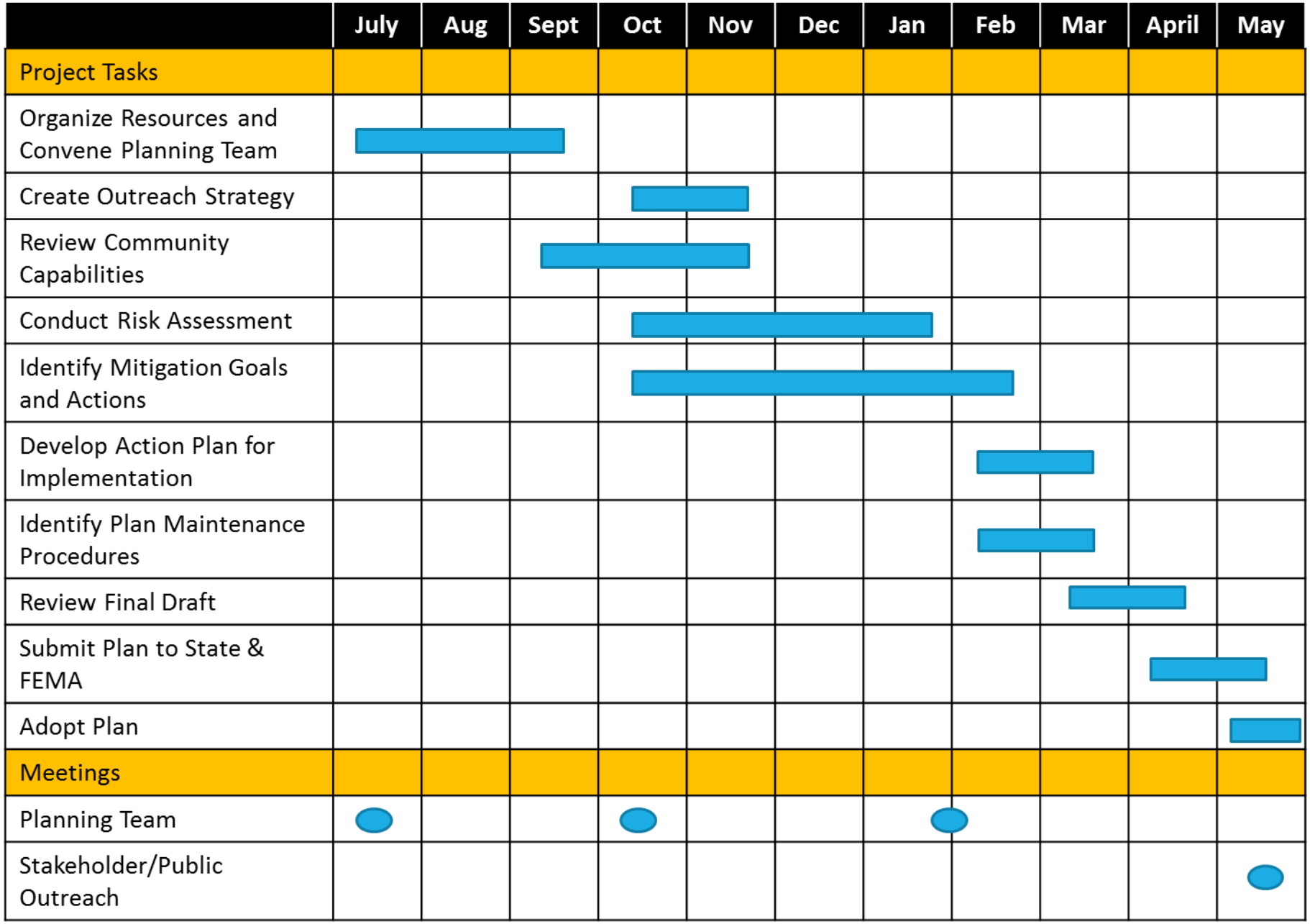
Mitigation Strategies

Status Update Collection Sheets -2012 Mitigation Actions were provided to the appropriate personnel for completion. A Mitigation Status Report will be included in the Plan Update within the Mitigation Strategies Chapter, as required by FEMA.

Cat each of the three sessions, committee members divided into groups to develop new mitigation items for inclusion in the *2016 Town of Ocean City Hazard Mitigation Plan.* After developing a minimum of two (2) new mitigation items, each group reported their ideas to all members.

Public Outreach
HMPC members discussed a potential public outreach project. A Spring newsletter is distributed to all residents. An article on the Hazard Mitigation Plan update may be inserted into newsletter. Bob Rhode and S&S staff will work with the Town PIO on this project.

Next Steps
• Distribution of Enhanced HAZUS Reports-Hurricane Wind & Coastal Flood • Development of Mitigation Strategies & Priority Ranking by Hazard Mitigation Planning Committee members. An Adobe Fillable PDF will be distributed. • Development of Draft Plan for local review and comment.


July
Aug
Sept
Oct
Nov
Dec
Jan
Feb
Mar
April
May
Project Tasks
Organize Resources and Convene Planning Team
Create Outreach Strategy
Review Community Capabilities
Conduct Risk Assessment
Identify Mitigation Goals and Actions
Develop Action Plan for Implementation
Identify Plan Maintenance Procedures
Review Final Draft
Submit Plan to State & FEMA
Adopt Plan
Meetings
Planning Team
Stakeholder/Public Outreach

Appendix I: Public Notices & Meeting Minutes

Ocean City, MD

2017